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INDUSTRIAL MUSEUMS

THE meaning of the word 'Museum' is 'temple of the Muses'. It denoted different things at different periods in history. Even libraries and places of literary study were once called 'museums'. The conception that it is a depository of curiosities and rarities is comparatively of recent origin. In Western countries, the period of explorations created and encouraged a great thirst in peoples' minds for the collection of beautiful and interesting objects from several corners of the world newly opened to them. One finds in the 17th century European princes, aristocrats, scholars and even clergymen keeping 'museums' as a mark of dignity and cultural superiority. During the 19th century the museum was no longer considered merely as a means of gratification to the aristocracy of rank and scholarship, but it was raised to the status of an important public institution meant to serve as a laboratory of research and an educational centre.

To-day every European country possesses museums which originated in the art collections of mediæval princes and nobles. Finding the enormous educational possibilities of the museum various governments have been following a consistent policy of encouraging, equipping and popularising the institution. The study of natural science was greatly facilitated by the collections of stones, plants, insects, animals, birds, etc., and the art pieces gathered and exhibited in the museum roused the creative spirit of European artists. The rapid increase in the number of museums in Europe and elsewhere bear ample testimony to their importance in modern society. It suggests

that a country that aspires to progress on modern lines will find in the museum not an instrument of negligible value but an institution necessary for the education and the enlightenment of the masses and the classes.

It is not an accident that the greater the industrialisation in a country, the more numerous are the museums organised. There are about 8,000 museums in the world to-day and about 6,500 of them are concentrated in the highly industrialised countries of Europe and in the U.S.A. The leading countries in industrial and scientific progress,—the United States and Germany—can boast of more than 1,500 museums each, while France and Britain maintain 1,200. Italy has 400 to her credit and the giant engine of Soviet educational propaganda makes use of 200 well-kept museums for the propagation of the principles of communism and for the instruction in the industrial arts. Imperial Japan is quick in imitating the West and she has rapidly developed 160 museums while the vast area of yellow China has only about 100 institutions. Taking the British Empire into consideration we find the figures are as follows:—Australia and New Zealand 160; South Africa 60; Canada 125. Against the background of European countries and the British Empire the fact that India possesses only 105 museums must be a matter of regret for those who are interested in the all-round progress of our country.

Museums are of different types: art museums, science museums, etc. But India requires institutions specially devoted to the dissemination of knowledge in crafts and industries, both of the past and the present. In other words, India requires the 'Industrial Museum' more than any other type. She is on the threshhold of industrial advancement and the industrialisation of the country calls for a very large number of museums where the average citizen may learn, at first hand, about the growth and possibilities of village industries and crafts, new mechanical devices, new products, etc. He must see in the exhibits before him the past glory of our industries, and their present decay. He will then feel it his duty to encourage national industries. His pride in our industrial past would generate a noble feeling of well-directed patriotism without which democracy is impossible. The Industrial Museum is a depository, not only of the past industries, but also of the present growing industries and crafts. It must stimulate the curiosity of the public and awaken the average man so that he may know, and wish to know, more about the world in which he lives. The visitor should be impressed by means of exhibits and explanations how our own country produces a hundred good things which he blindly purchases from the foreigner, and how the dying and dead crafts can be resuscitated only if he is an intelligent and patriotic purchaser in the market. I am sure that there are thousands of educated people who purchase foreign products just because they are not aware of the progress in indigenous manufacture. If those men and women are attracted to the industrial museum, is there any doubt that the cause of *Swadeshi* would be well served? Many do not know the processes in the manufacture of articles they buy and use. A visit to the museum will enlighten them and increase the craving for further development. In recent years we hear politicians raising the slogan, "Go back to villages". How useful would industrial museums be in the attempt at educating the artisans and the peasants of the villages in

the simple crafts and rural industries so that their standard of living may be slowly, but surely, raised! The Wardha Scheme of Education aims at giving our school-boys instruction in useful crafts and industries. Gandhiji's scheme may be well served by the institution of industrial museums all over our country, in important centres, so that school children may be taken to the museums regularly—as they do in the United States of America and in Soviet Russia—and there taught the principles and processes of the manufacture of the articles in daily use.

At present, for a population of 350 millions spread over two million square miles, we have only 105 museums and very few of them are specially devoted to the industries. Even many of our cities are without any industrial museums. Recently there is a healthy trend towards the establishment of industrial museums in our important cities. The part played by the Congress and other national organisations in establishing technological museums deserves our praise. But one should remember that in the absence of generous help from the Government, the responsibility of encouraging industrial museums rests largely with the public. We hope that our Universities, municipalities and other public bodies would come forward in organising well-equipped museums for the rapid industrial, educational and cultural progress of India.

B. V. NARAYANASWAMY.

'ASCU' WOOD PRESERVATIVE

"PENDING clarification of these and other obscure points the Forest Research Institute has decided to withdraw its publication, 'Ascu'—A wood preservative, *Indian Forest Records* (New Series), *Utilisation*, Vol. I, No. 6, and to postpone its re-issue in a revised form until the results of further research and adequate service tests are available." This announcement is contained in a note issued by the Forest Research Institute, Dehra Dun, under the signature of Mr. L. Mason, President of the Institute.

This very unusual procedure of formally withdrawing a scientific publication originally issued under official authority raises a number of points which are not rendered any simpler by the fact that the process in question is covered by a patent which has been commercially exploited in India and, it is learnt is under active consideration even outside. When reviewing the publication *'Ascu'—A Wood Preservative* (*Curr. Sci.*, 7, No. 3, p. 141), attention was drawn, in particular to two facts; first on the mass of data and a century of experience which the older creosote and zinc chloride processes had behind them and which 'Ascu' on account of its infancy could not possibly have, and secondly, on the lack of a bibliography of relevant literature in the publication. And although the Foreword to the *Record*, explicitly warned that it was "too early to pronounce a definite or final opinion on its merits or limitations", it must be confessed that this withdrawal was entirely unexpected. The Forest Research Institute took on itself a heavy responsibility in originally recommending the process and sponsoring the official publication and its responsibility is no less onerous in withdrawing its official *imprimatur* now after more than six years. It is not merely the future of a particular process that is involved now; it is the future of a pioneer industry still in the nascent stage. Public acceptance in India of wood preservation processes as such, is definitely hampered by these unfortunate developments relating to 'Ascu'.

ROBERT ANDREWS MILLIKAN

(Chairman of the Executive Council of California Institute of Technology and Director of the Norman Bridge Laboratory)

ON March 22nd, 1868, Robert Andrews Millikan was born in a small town of Illinois. After graduation from the local high school he went to Oberlin College in Ohio, where in 1893 he received the Bachelor's Degree, and two years later the Master's Degree. He then went to Columbia University in New York City for his doctorate in Physics. Before beginning a brilliant career in Chicago University he went abroad for a year's further study in Berlin and Göttingen.

In addition to routine teaching during his twenty-five years in Chicago, Prof. Millikan found time and energy for an immense amount of fruitful research and writing. He found time also for popular lectures and a great variety of campus and community service. To him must go much credit for his part in the movement which is helping to educate the general public to the significance of modern science. His text-books in elementary physics, in particular, have greatly contributed to a new conception of science teaching. They help both student and teacher to see physics as a living, growing science intimately related to our everyday life.

Professor Millikan's intellectual curiosity and contagious enthusiasm are everywhere evident in his lectures and writings. His ingenious speculations, based on scientific data, catch the imagination and hold the interest of his readers, and whet their appetites for more information. It will be a great day for humanity when the average student of the sciences—and of other subjects—will be caught and drawn on in his studies by an irresistible curiosity rather than be driven by the corrosive fear of impending examinations. In order to help bring about the new day we need many teachers and writers of text-books (if indeed texts are to survive!) such as Professor Millikan who, by their own keen insight and their vigorous, friendly personalities, will inspire students to develop the best that is in them.

In recognition of Professor Millikan's notable contributions to the advancement of knowledge, he has been awarded many honorary degrees by the great Universities of Europe and America. Gold Medals have been showered on him and many learned societies have honoured themselves and him by enrolling him on their membership lists.

Dr. Millikan's beautiful determination of the charge on the electron won for him in 1923 the much-coveted Nobel Prize and will long remain an outstanding example of human ingenuity. The refined simplicity of theory and laboratory technique enhance the elegance of this classic work. Professor Millikan once said, "If the Nobel Prize had not been awarded to Albert Einstein for his work on the Photo-Electric Effect, it might well have been given to him for any one of four or five other outstanding contributions". Similarly it may be said that if this rare Prize had not been given to Doctor Millikan for measuring the charge on an electron it might have been awarded to him for his own beautiful photo-electric measurements, or for his pioneering work in spectroscopy or the cosmic rays.

The titles of Professor Millikan's books indicate that in addition to his work in classroom and laboratory, he has found time to consider the significance of science for human welfare and to direct the attention of his readers to their responsibility for the right use of the new power which science is so rapidly conferring on immature men.

At the age of seventy-two (nearly), Prof. Millikan is not only the active head of one of the world's foremost schools of technology and director of its physics laboratory, but also finds time for committee work of international importance, and for continuous intensive research in his own special field of cosmic radiation. At the present time he, with Mrs. Millikan and two able collaborators, Dr. Victor Neher and Dr. W. H. Pickering, is in India collecting data on cosmic ray intensities in the stratosphere.

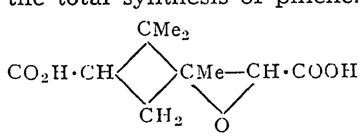
J. M. BENADE.

PROFESSOR L. RUZICKA

THE work of Ruzicka can be broadly divided into three distinct groups: (*a*) his earlier work on quinatoxins, (*b*) his researches on the higher carbon ring compounds, and (*c*) his extensive researches on the chemistry of terpenes and allied bodies, including the sterols and resin acids. In this short article an attempt will be made to present an account of his work in a connected manner so that a proper perspective could be formed of his brilliant achievements.

Researches on terpenes and allies.—Ruzicka's first published paper[1] was with Staudinger in 1911, when he published some work on the ketenes. After this, there is a long gap and his next paper[2] was published in 1918 in which he described a complete synthesis of fenchone. The conversion of borneol into camphene has been explained hitherto in two ways by the assumption, on the one hand of a tricyclene and on the other, of a substance containing bivalent carbon. From the first, camphene would result by the fission of the trimethylene ring. Whilst in the case of a secondary alcohol such as borneol the above two explanations are possible, the Wagner rearrangement of a tertiary alcohol is possible only through a tricyclene. Methyl borneol and methyl fenchyl alcohol both give on dehydration the same mixture of hydrocarbons from which both camphor and fenchone are obtained on ozonisation. The reaction can be explained only if a common tricyclene be assumed to be formed from both tertiary alcohols.[3]

In 1919, a synthesis of linalool[4] was effected by treating the sodio derivative of methyl heptenone (formed with sodamide) with acetylene in dry ether. The dehydro linalool formed was ingeneously reduced with sodium and traces of water to linalool. In 1921, considerable progress[5] was made towards the total synthesis of pinene. Ethyl



I

γ-pinonate was condensed with ethyl chloroacetate to a glycidic ester from which the acid (I) was prepared. The latter was converted by heating *in vacuo* to the semialdehyde of homopinocamphoric acid. The Dickemann reaction on the ester gave γ-pinocamphone. Since α-pinene has already been obtained from the corresponding alcohol pinocampheol, therefore a partial synthesis of pinene was claimed.

In 1922 began a series of investigations on the dehydrogenation of terpenes with sulphur which paved the way for the final elucidation of structure of many members of this group and the related substances. A substantial advance in our knowledge of the sesqui-terpenes[6] resulted from the investigation of the nature of aromatic substances produced by heating them with sulphur. The dehydrogenation of cadinene, calamenol, zingiberene and the sesqui-terpene from Javanese citronella oil gave one and the same hydrocarbon, $C_{15}H_{18}$, termed cadalene which was proved by synthesis to be 1:6-dimethyl-4-isopropyl naphthalene.

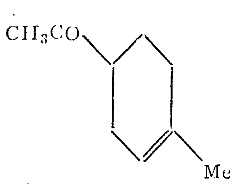
A complete synthesis of nerolidol and farnesol[7] was occomplished by condensing $\alpha\beta$-dihydro-ψ-ionone, $Me_2C:CH.CH_2.CH_2.CMe:CH.CH_2.CH_2.COCH_3$, with acetylene, as in the case of the synthesis of linalool, and dehydro dl-nerolidol was obtained. The reduction of the latter with sodium in moist ether gave dl-nerolidol [$Me_2C=CH.CH_2.CH_2CMe=CH.CH_2-CH_2-CMe(OH)-CH=CH_2$] which passed into farnesol with acetic anhydride. The formation of eudalene from eudesmol and selinene, established that in the biogenesis of the terpenes the three isoprene residues joined end to end (as in farnesol) can be coiled up to produce the cadinene frame work and also may coil up in two other alternative manners, of which eudalene represents one type. When farnesene is treated with acetic acid containing a little sulphuric acid,[8] it is converted into the acetate of α-bisabolol; the alcohol on treatment with hydrogen chloride gives a trihydrochloride identical with natural bisabolene from oil of opopanax. Since farnesene[7] had been synthesised from geranyl chloride *via* dihydro-ψ-ionone and nerolidol, hence a complete synthesis of bisabolene was accomplished.

The structure of zingiberene was investigated and the carbon skeleton of zingiberene was proved to be the same as that of bisabolene.

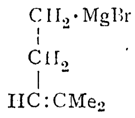
The constitution of santonin was investigated by Clemo and Haworth who synthesised desmotroposantonin and more or less

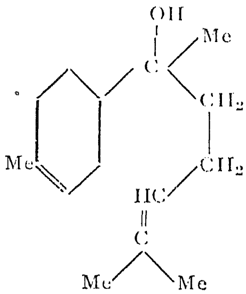
settled its constitution but proof was still needed for the position of the methyl group. Ruzicka dehydrogenated with selenium the Clemmensen reduction product of tetra-hydro-santonin and isolated 1-methyl-7-ethyl-naphthalene[10] which thus placed it in the eudesmol (selinene) group of terpenes.

The synthesis[12] of bisabolol and bosabolene was accomplished as follows: The ketone II, obtained by ozonolysis of β-terpeneol was condensed with the Grignard reagent from ε-bromo-β-methyl Δ^2-pentene

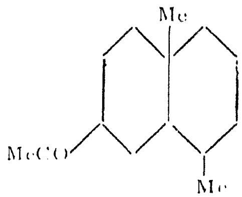


II





III



IV

giving bisabolol III. This synthesis removed all doubts as to the position of the double bond. The conversion of the dehydration product of dihydro-eudesmol by ozonolysis into acetyl dimethyl decalin of the structure IV proved the position of the hydroxy group in eudesmol.

The oxidation of abietic acid with excess of permanganate gives two acids,[13] $C_{11}H_{16}O_6$ and $C_{12}H_{18}O_6$. The former is dehydrogenated by selenium to *m*-xylene and the latter to 1:2:3 trimethyl benzene. From this the conclusion was drawn that the methyl group which is lost in the dehydrogenation of abietic acid to retene occupies the 12 and not the 11 position as hitherto supposed. The position of the carboxyl group in abietic acid was determined by the researches of Ruzicka and Haworth and the fact that the acid and its ester combine with maleic anhydride[14] proved the presence of a system of conjugated double bonds and thus the skeleton of abietic acid was conjectured. The suggested formula of abietic acid, however, is only derivable from irregular isoprene chains. It has now been shown by Wienhaus[22] *et al* that abietic acid and maleic anhydride do not react below 130° to an appreciable extent. The primary acids of pinus sylvestris react at ordinary temperature both with maleic anhydride and benzoquinone. Therefore the conjugated double bonded system in abietic acid is unproved and the spectroscopic and refractometric measurements also do not indicate it.

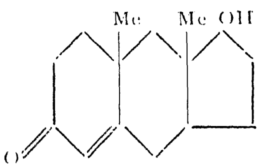
The stereochemical problems arising out of the *cis*- and *trans*-locking of the polycyclic hydroaromatic compounds present an almost insurmountable obstacle in the determination of structure of these bodies. Refractometric measurements[15] and a comparison of m.ps. of different derivatives with those in the decalin series indicate that cholestane has a trans-trans-cis or trans-trans-trans configuration. It has been pointed out that the trans fusion of the rings II and III may well account for the non-formation of ketones from 1:6 dicarboxylic acids obtained by the opening of ring II or III. Much of the work on the stereochemistry of the sterols is due to Ruzicka[28] who has dealt with the assignment of the configurations. Practically all the known steroids belong to one of two ring systems: (*a*) the cholestane type or (*b*) coprostane type. These differ in the orientation of the hydrogen on C_5 relative to 10-methyl group which is *trans* in type (*a*) and *cis* in type (*b*). Ruzicka's view is that cholestanol has the locking trans, trans-antitrans-antitrans configuration. The hydrolysis of acetates and benzoates of epimeric pairs (*a*) cholestanol and epicholestanol, (*b*) coprostanol and epicoprostanol, (*c*) cholesterol and epicholesterol showed that all compounds denoted as *trans* were more readily hydrolysed than the *cis*-epimerides.

The original Rosenheim-King formula was based on the formation of chrysene by the dehydrogenation of cholic acid. Ruzicka re-investigated the problem but could not find any chrysin. Ergosterol gave a hydrocarbon $C_{26}H_{26}$, the next higher homologue of the hydrocarbon $C_{25}H_{24}$ produced from cholesterol. The synthesis of Diel's hydrocarbon by Bergmann and Hillemann showed that during selenium dehydrogenation the migration of a methyl group occurs and the value

of this method becomes thus questioned. However, subsequent researches from many countries have now proved the conditions under which an angular methyl group may migrate and therefore the method is still a valuable one for determining structure.

Androsterone.—The male sexual hormone $C_{19}H_{30}O_2$ isolated in minute quantities was proved to be a hydroxy ketone. Its sterol-like structure was merely surmised. Ruzicka[17] found that β-cholestanyl chloride and cholestanyl acetate could be oxidised by chromic acid to ketones in which the side chain is completely removed. In a later paper the oxidation[18] of three remaining isomerides of cholestanyl acetate was described. The substance derived from epi-dihydrocholesterol had an activity equal to that of the natural hormone and was identical with it. Ruzicka has suggested that androsterone arises in nature by a process similar to that by which it is prepared *in vitro*—epimerisation of the hydroxy group of dihydrocholesterol followed by the oxidation of the side chain.

The question of the activity of these hormones has been studied and it has been found that androstane diol[19] is four or five times more active in promoting growth of comb but only slightly more active in promoting vesicular growth than androsterone. The most active of all is testosterones, a substance isolated from tests by Laquer,[20] which is five times as active as androsterone in promoting growth of comb and twenty times more active in promoting vesicular growth. The structure of testesterone[21] was shown to be



David[23] confirmed this view by oxidising it to androstene 3 : 17 dione.

It seems that testesterone is the true hormone and that androsterone and related substances are products of its metabolism.

It was shown by Laquer that testesterone displays its maximum biological activity only in presence of an 'X-substance' present in testicular extracts. It was shown that by esterification of testesterone, its activity is much enhanced. The most active ester was found to be the propionate[24] which is now used clinically under the name 'perandren'.

The Triterpenes.—The determination of m.w. of triterpenes presents many difficulties. Recent investigations have shown that many of these compounds may have as many as 30 C atoms.[25] The functional groups are difficult to detect. The CO group in $\alpha\beta$-unsaturated ketones could only be detected spectroscopically and the acid groups would not esterify under ordinary conditions. The action of ozone is unreliable and perbenzoic acid gives unsatisfactory results.

The results of dehydrogenation of the triterpenes are now available and much of the information has been supplied by Ruzicka and his collaborators. As a result of these investigations the structure of oleanolic acid and hederagenin are now fairly clear.

The isoprene rule is now so firmly established that more than usual interest attaches to the problem of the structure of artemesia ketone which violates the isoprene rule. The structural position has been consolidated by the synthesis[26] of its tetrahydro derivative from $\alpha\alpha$-dimethyl butyryl chloride and *iso*-butyl zinc iodide $CHMe_2.CH_2ZnI + ClCO.CMe_2Et = CHMe_2.CH_2.CO.CMe_2Et$.

Large carbon rings.—The preparation of the ring ketones by the distillation of the calcium salts of normal $\alpha\omega$ fatty dicarboxylic acids has been restricted to the preparation of C_5, C_6 and C_7 cyclic ketones which can be obtained in about 30% yield. The cyclo octanone prepared by this method was found to be a mixture. Ruzicka[29] showed that 5% pure cyclo-octanone could be prepared from calcium azelate and 10% from cerium azelate. By the use of thorium salts the yield could be increased to 25%. The identification of by-products (cyclohexanone and nonanone-2) proved that the azelaic acid underwent fission to a pimelate and an acetate. Cyclononanone was also prepared in poor yield, due no doubt to the fission of the dicarboxylic acid. The higher ketones C_{10} to C_{18} were obtained by the vacuum distillation of the corresponding thorium salts. The yield of the ketones passed through a minimum (0·1–0·2%) at C_{10} and thereafter rose. The odour of the ketones resembled civet from C_{16} to C_{18}. According to the classical theory of Baeyer, the strain in a cycloheptadecane is $-24°41'$ whilst a cyclopropane has $+24°44'$. But the cyclic ketones from C_7 to C_{18} underwent no change when heated with concentrated hydrochloric acid

at 180–200°. Cycloheptadecanone was passed over thoria at 400–420° and was recovered unchanged. Therefore, it became clear that the larger rings relieved their strain by throwing up some of the carbon atoms in space. This was evident from the consideration of volume contribution of CH_2 in an alkane and a cycloalkane. The volume contribution of CH_2 in an alkane is 16·1, whilst the following values were obtained for cycloparaffins:

No. of CH_2 groups	4	5	6	7	15	17
V/n	20·4	18·8	18·0	17·3	16·1	16·1

The values for the smaller rings represent the volume occupied by CH_2 groups *plus* a share of the internal space. From C_{15} onwards the carbon atoms completely fill up the internal space and hence the value becomes equal to the CH_2 of an alkane. The value for heat of combustion of the methylene group has been found[30] in large rings to be 156 to 157 Kg-Cals. This corresponds to 157 Kg-Cals. for the methylene group in a paraffin and thus there can be no doubt as to their multiplanar configuration.

The structure of muscone (the ketone of musk) was found to be a methyl cyclopentadecanone and civetone, the ketone from civet cat was proved to be a heptadecanone. The synthesis[31] of *dl* muscone was effected in 1934 and in 1935 members of the C_{33} group were described as also the preparation of 7 to 18 membered saturated and unsaturated cyclic imines.[32] Civetone was converted into *iso*-oxime by ammonia and hydrochloric acid in benzene, the *iso*-oxime was converted into thio-oxime and then reduced with sodium and acetic acid in ethanol and heptadecamethyleneimine isolated. The polymethylenes (16 membered) attached to a benzene ring in *meta* and *para* position[33] were also prepared.

The modified quinatoxins.—Ruzicka[34] prepared a series of quinatoxine like compounds, *e.g.*, 4-quinolyl-(ε-aminopentyl) ketone, 4-(6-methoxyquinolyl ε-aminopentyl ketone, 4-pyridyl δ-methylaminobutyl ketone, 4-(6-methoxyquinolyl)-(δ-aminobutyl)ketone, etc. These compounds were tested by Giemsa but found to have no curative value. These experiments are significant in view of the later discovery of plasmoquin.

The above summary gi... idea as to the versatility... The recognition of his ... of a Nobel Prize is an ... workers in organic chem... branches of science, work... try involves considerabl... the results have little ... public.

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1 *Annalen*, 1911, **380**, 278-30...
2 *Ber.*, 1917, **50**, 1362–74.
3 *Helv. Chim. Acta.*, 1918, **1**, ...
4 *Ibid.*, 1919, **2**, 182–88.
5 *Ibid.*, 1921, **4**, 666.
6 *Ibid.*, 1922, **5**, 345, 562, 71...
7 *Ibid.*, 1923, **6**, 483–502.
8 *Ibid.*, 1925, **8**, 259.
9 *Ibid.*, 1924, **7**, 379.
10 *Ibid.*, 1930, **13**, 1117.
11 *Ibid.*, 1930, **13**, 1402.
12 *Ibid.*, 1932, **15**, 3.
13 *Ibid.*, 1925, **8**, 637.
14 *Ibid.*, 1932, **15**, 1289.
15 *Ibid.*, 1933, **16**, 327.
16 *Ibid.*, 1933, **16**, 216, 812.
17 *Ibid.*, 1934, **17**, 1387.
18 *Ibid.*, 1934, **17**, 3519.
19 *Ibid.*, 1935, **18**, 210.
20 *Z. Physiol. Chem.*, 1935, **23**...
21 *Helv. Chim. Acta*, 1935, **18**, ...
22 *Ber.*, 1936, **69**, 2198.
23 *Acta. Brev. Neerl*, 1935, **5**, ...
24 *Helv. Chim. Acta.*, 1936, **19**...
25 *Ibid.*, 1932, **15**, 472; 1936, **19**... 312.
26 *Ibid.*, 1936, **19**, 646.
27 *J. Soc. Chem. Ind.*, 1935, **5**...
28 *Helv. Chim. Acta.*, 1936, **19**, ...
29 *Ibid.*, 1926, **9**, 389.
30 *Ibid.*, 1933, **16**, 162.
31 *Ibid.*, 1934, **17**, 1308.
32 *Ibid.*, 1935, **18**, 659.
33 *Ibid.*, 1932, **15**, 1220.
34 *Ibid.*, 1924, **7**, 995.

THE SEVENTH INTERNATIONAL CONGRESS OF GENETICS

The Seventh International Congress of Genetics held at Edinburgh during August-September last year was one of the most unique in the history of scientific conferences. Meeting under the threat of a great political upheaval, it achieved probably more than any previous session. And that it was held at all was due to the untiring efforts of Prof. F. A. E. Crew and his colleagues on the Committee. Originally Prof. N. I. Vavilov was to have presided over the deliberations but only about a fortnight before the session, information having been received of his inability to attend, Prof. Crew was elected to the chair. The Russian contingent of delegates failed to arrive at the last moment and the German geneticists had to withdraw, and in the face of these set-backs the determination to carry on and to continue the deliberations is itself an example of the undying spirit of Science.

Important contributions were made to our knowledge of the gene and the chromosome theory. The variations in the behaviour of the chromosomes at meiosis were shown by Darlington to be due to the changes occurring during the process of pairing of the chromosomes, while the structural changes in the chromosomes were shown by Muller to be due to a breakage of the chromonema at two or more points followed by a two-by-two junction between the adhesive broken ends, giving a new linear order. Another important new point brought to light was that the variations in the staining of the chromosomes were correlated with variations in gene activity. The cause for gene mutation was determined by Timoféeff-Ressovsky that it was due to atomic activations, brought about by kinetic energy of thermal origin and to individual ionizations resulting from radiation. The effect of ultra-violet light on chromosomes was discussed by Stadler and others and the experiments of Muller and Mackenzie showed that it was probable that ultra-violet light did not act by breaking the chromosomes, thereby concluding that gene mutations did not consist merely in linear rearrangements. Stadler also showed that gene mutations often affect only one of the chromatids.

Probably never before was the close association between gene change and chromosome change so clearly demonstrated and this was done in regard to *Drosophila* by the American geneticists. This has brought genetics and cytology into such an intimate unity that the two are being used as a "joint tool of evolutionary research".

The effect of genes on physiological and embryological processes was dealt with in a number of papers. The development of abnormalities was discussed by Landauer who showed that teratological phenomena could be explained by a general deleterious effect on growth rate at certain critical periods in development. Another important contribution to the section of physiological genetics was that by Sewall-Wright on guinea-pig coat colours where he suggested a scheme for the relations of the known genes in this animal.

The Congress made definite advances in our knowledge of the breeding and improvement of live-stock. Discussions on the adaptability of cattle to varied environments revealed certain significant differences, as observed by Manresa and others, in the hæmoglobin content of the blood in relation to atmospheric conditions.

The importance of statistical methods of inquiry in regard both to animal and plant genetical experiments was discussed at one of the joint meetings and it was seen that while at present the full benefits of statistics were not available to the plant and animal breeder on account of the inherent difficulties involved in the collection and evaluation of records, detailed analyses of statistical data were necessary for the correct interpretation of genetical phenomena. In fact, one of the general resolutions of the Congress lays stress on statistical studies and recommends the study of statistics in secondary institutions. In the field of plant breeding, the experiments on the breeding of maize has advanced farther than in any other cereal but it is probably in the field of horticultural breeding that the collaboration of genetics and cytology is seen at its best and most successful. The Edinburgh meeting has definitely paved the way for a successful tackling of the problem of devising the most effective and fruitful methods of collaboration between genetics, cytology and statistics.

A number of aspects of human inheritance were discussed, of which feeblemindedness

was dealt with by Fraser Roberts who believes that it is a case of multifactor inheritance, there being a number of genes, any pair of which are able to determine idiocy or imbecility. The genetics of many other diseases like epilepsy and Pick's disease were also discussed. Interesting cases of linkage were brought to light, like that between tooth deficiency and hair colour, reported by Barbara Burks. Reports on a number of disorders and abnormalities were also made.

The phenomenon of growth, normal or abnormal, as examined by the genetical viewpoint offers interesting study and as observed by E. B. Ford, growth may be determined by a single pair of factors or by numerous ones which might affect growth by co-operation. It is also necessary to make a distinction between cell-growth and division on the one hand and body growth on the other and it is probable that the genetic influence may affect the former directly and the latter only indirectly. The effect of the endocrine organs on general body growth is well known and any genetical influences on the former will produce consequent results on the latter. A study of cancers and tumours has shown that the growth of these comes under the influence, not only of genetical but also of environmental factors.

Wider aspects of genetical research and their bearing on general problems of evolutionary biology were discussed in a special session. The observation that evolutionary change taking place not only under laboratory conditions but also in Nature must be investigated, was made by Dobzhansky. The bearing of taxonomy on evolutionary phenomena was stressed by J. S. Huxley who observed that the study of taxonomy was the study of evolution in action in the field.

B. R. S.

THE ANATOLIAN EARTHQUAKE OF DECEMBER 27, 1939

BY

A. R. PILLAI AND M. R. RANGASWAMI

(Colaba Observatory, Bombay)

A DISASTROUS earthquake occurred in Anatolia at $5^h\,27^m$ I.S.T. ($1^h\,57^m$ Turkish Standard Time) on December 27, 1939. The shock was recorded as one of great intensity by the seismographs at the Indian Observatories and the tentative epicentre as determined on the basis of the data reported from Agra, Calcutta, Kodaikanal and Colaba is found to lie in the region of Lat. 40° North and Long. 36° East, that is about 40 miles to the southwest of Tokat in Asia Minor. From a long time Asia Minor has been known to lie in one of the two major seismic belts in the world and has been visited by destructive earthquakes. According to Davison,[1] there were 48 destructive earthquakes in this region during the nineteenth century alone. From 1900 to 1928 nine large shocks were recorded in the same area. After a lull of about ten years this region appears to have once again become active. On April 19, 1938, a disastrous earthquake occurred in this region and the epicentre as located on the basis of the Indian seismograms was at Lat. 40° N. and Long. 33° E. This shock resulted in the complete destruction of ten villages; the number of victims exceeded 800. A slightly less destructive earthquake was also reported to have occurred on September 22, 1939, in the neighbourhood of Smyrna and the epicentre was found to be near Lat. 37° N. and Long. 26° E., about 100 miles away from Smyrna in the Aegian Sea. In this case, according to Reuter's news report, several villages around Smyrna were destroyed and more than 200 people killed. Another destructive shock, but less severe in its havoc, occurred in Anatolia, on November 23, 1939, but the Colaba records did not show clear phases. Sixteen villages were destroyed and 43 people were killed. These earthquakes were followed by the present catastrophic shock of December 27, 1939. According to the press reports so far received, fifteen provincial towns and ninety villages and hamlets were reduced to ruins and more than 39,000 people killed as a result of this earthquake. The shock was particularly severe in the agricultural regions between Tokat and Sivas, and in the districts of

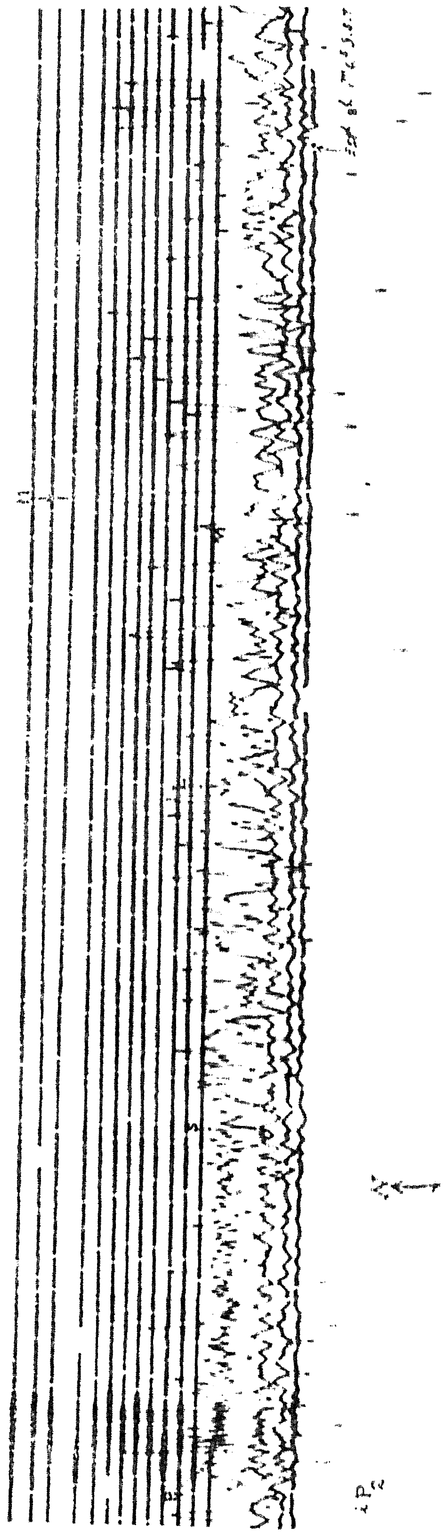


Fig. 1

Erzinjan and Kemakh every town and village is a heap of wreckage. The estimated total area that was severely affected by the shock is about 60,000 square miles.

The seismogram of this earthquake as recorded at Colaba by the Milne-Shaw seismograph (N-S component) is reproduced in Fig. 1. The first movements in the seismograms of the Colaba N-S and E-W components are very small as compared with the intensity of the shock. It is considered probable that the larger shock was preceded by a small foreshock with an interval of about 25 seconds between them. It is rather difficult to make any definite statement regarding the depth of focus of the shock until seismograms from other stations also are examined. It can, however, be said that the Colaba seismograms appear to show that the earthquake was not of abnormal depth. Considering the extent of the area affected it is probable that there were more than one shock with different epicentres along the same belt.

The magnitude and energy of the shock have been calculated from Colaba records only, following the method of Gutenberg and Richter.[2] The value of the magnitude comes to 7·1 and that of the energy of the earthquake, 10^{24} ergs. The other catastrophic earthquake in the year 1939 was the Chilean shock of January 25, 1939. The magnitude and energy of this earthquake were found to be 7·5 and 10^{25} ergs respectively.[3] Thus the energy released by the present Anatolian earthquake is about one-tenth that of the Chilean shock though in the matter of destruction of human life and property the former exceeds the latter. The magnitude and energy of this Anatolian earthquake is almost equal to those of the Baluchistan Quetta earthquake of May 31, 1935. But in loss of life, the Anatolian earthquake with a toll of above 39,000 lives almost ranks with the Messina Reggio earthquake of December 28, 1908, which so far holds the record with the greatest death toll of over 47,000 as a result of the earthquake alone.

[1] *Earthquakes and Other Earth Movements*, by John Milne. Revised by A. W. Lee, 1939, p. 113.

[2] *Gerlands Beiträge zur Geophysik*, 1936, **47**, 122–24.

[3] Savur, S. R., and Mukherji, S. M., *Curr. Sci.*, 1939, 8, 156.

CRYSTAL PHYSICS AND CHEMISTRY

UNDER the auspices of the fifth annual meeting of the Indian Academy of Sciences a symposium on "Crystal Physics and Chemistry" was held at Bangalore on the 31st December 1939. PROF. SIR C. V. RAMAN, the President of the Academy, was in the chair.

PROF. K. S. KRISHNAN spoke on the Stark splitting of the energy levels of paramagnetic ions in crystals under the influence of the strong electric fields due to the distribution of negatively charged atoms surrounding the paramagnetic ion. Three properties of the crystals which are largely affected by this are the optical properties, specific heat and the magnetic properties. In particular, the effect of this splitting on the magnetic behaviour of the ions throws considerable light on the origin of the magnetic anisotropy in a paramagnetic crystal. In crystals the orbital moments of the ions are partially quenched by the asymmetric crystalline electric fields. The spin moments, on the other hand, are not affected directly by the crystalline fields though indirectly they would be through their coupling with the orbital moments. The ground states of ions such as Mn^{++} Fe^{+++} and Gd^{+++} being S-states, there are no orbital moments to be quenched, and the magnetic moment is wholly due to the spin. The anisotropies in such cases are very feeble and arise from the Stark splitting of the S levels. From the magnetic data at room temperature, it is possible to get an idea of the Stark separation, the restriction of freedom of the ions, as well as the characteristic temperatures in the case of manganous and ferric salts. In the case of trivalent chromium, Cr^{+++}, also the magnetic moment is wholly due to the spin and it has, therefore, only a small anisotropy which follows the inverse square law with temperature. From the measurements on the magnetic anisotropy of nickel salts at different temperatures the strength of the coupling between the orbital and spin angular momenta of Ni^{++} has been calculated and is found to agree with the spectroscopic value. The striking contrast in the magnetic behaviour of the six co-ordinated and four co-ordinated cobalt compounds can be explained as due to the mutual inversion of the Stark levels of the Co^{++} ions in crystals. The effect of the spacing of the levels on the colour of the substances is also striking as the six co-ordinated cobalt compounds are pinkish whereas the four co-ordinated ones are blue. The phenomenon of magnetic double-refraction observed by Raman and Chinchalkar in solutions of rare earth salts can also be readily explained as being due to the asymmetric quenching of the orbital moments of the paramagnetic ion in the electric fields due to the surrounding anions, since the paramagnetic complex will then possess both magnetic and optical anisotropy. In the case of the solution of salts of Gd^{+++} the magnetic double-refraction is extremely feeble as is to be expected since Gd^{+++} is in the S-state and hence there is practically no magnetic anisotropy of the complex. Further, it has been observed that the Stark components in the absorption bands of crystals of certain rare earth salts have different polarisation characteristics, thus clearly demonstrating the existence of asymmetric crystalline fields in these crystals.

PROF. S. BHAGAVANTAM gave a brief review of the present theoretical conceptions about the dynamics of the crystal lattices and the recent progress made in the study of the scattering of light in crystals. From Born's theory of crystal lattices, the modes of motion can be classified into two fundamental groups: (1) the acoustical series same as the Debye heat waves due to the simultaneous translatory motion of all the atoms defined by the elastic properties of the crystal, and (2) the optical series occuring in Raman effect and infra red absorption which consist in the oscillation of the ultimate constituents that go to make up the crystal lattice, against each other. In class (2) the periodicity of oscillations of the set of atoms in space can be so varied as to get different modes of oscillation. However, only those modes are important in light scattering where all the atoms move in phase to produce the necessary polarisability changes. The change of symmetry of the crystal changes the number of distinct modes, the higher the symmetry the smaller being the number of these modes. One of the important symmetry elements is the centre of symmetry. The significance of the location of the centre of symmetry is clear from the different behaviour of sodium chloride as compared to that of diamond in light scattering. The geometric arrangement of the scattering units in crystal lattices

and their simplicity render the results obtained by light-scattering both accurate and easy of interpretation. One can get a variety of information from studies of the Raman effect in single crystals under different experimental conditions. The lecturer showed how the recent directional studies on calcite and sodium nitrate enabled one to draw important conclusions regarding the dynamics of their lattices.

DR. C. S. PICHAMUTHU detailed the mineralogical aspect of various properties of crystalline rocks. He referred briefly to the use of the more common optical instruments such as the polarisation microscope and the Federow stage to determine the optical constants of minerals. The optical anomalies such as the occasional biaxiality and anomalous interference colours shown by hexagonal crystals like quartz and garnet have puzzled the mineralogists till now. In the case of lavas and spherulites which are formed in a fine state of crystallisation, the mineralogist has recourse only to X-ray studies to find out their structure. In the case of ore minerals, studies are made by reflected light and by etching methods because of the opacity of the crystals. However, the study of the distribution of components in the ore samples is rather difficult. The lecturer then dealt in detail with the formation and characteristics such as the orientation effects in stress minerals.

PROF. SIR C. V. RAMAN gave suggestions regarding the methods to be adopted in resolving some of the optical anomalies observed in minerals and stressed the possible influence of irregularities and crystal imperfections such as the mosaic structure on the optical behaviour of crystals particularly in light scattering.

MR. T. M. K. NEDUNGADI drew attention to the usefulness of the study of light scattering in crystals in the explanation of their various physical properties. He showed how his studies of the Raman spectrum of quartz at high temperatures have given an insight into the probable mechanism of the α β transformation in quartz.

Some interesting new results obtained from studies on the luminiscence, light-scattering and light absorption in diamonds were presented by MR. P. G. N. NAYAR. Diamonds in general have a number of fluorescent bands. But among the different crystals there is wide variation in their intensities. Certain correlations between the frequency differences of the luminescent bands and infra-red and ultra-violet absorption were pointed out and discussed.

T. M. K. NEDUNGADI.

A NATIONAL RESEARCH COUNCIL FOR INDIA

IN the December Number of *Current Science*, in an Editorial we pleaded strongly for the immediate inauguration of a National Research Council, on lines similar, in essentials, to the Department of Scientific and Industrial Research in Great Britain, for organising industrial research in this country. It is gratifying to learn that this suggestion has received strong support from the scientists of this country who had assembled at Madras under the auspices of the Indian Science Congress. At a meeting held on the 5th of January, under the Presidentship of Sir T. Vijayaraghavacharya, various speakers, including Profs. J. N. Ray, S. P. Agharkar and J. N. Mukherjee, spoke on the role of science in national planning and drew attention to the existence of lacunæ in our scientific organisation. The inauguration of a National Research Council at this stage of scientific development in India, was considered essential for an ordered utilisation of the industrial resources of the country. In bringing the proceedings to a close, Sir T. Vijayaraghavacharya mentioned that as long ago as 1931, he had suggested the formation of a national council of research for organising not only agricultural but also industrial research. He felt that the formation of such a body was long overdue.

A Committee consisting of Sir T. Vijayaraghavacharya (*President*), Prof. Birbal Sahni, Dr. J. C. Ghosh, Bt.-Col. R. N. Chopra Prof. M. N. Saha and Prof. P. Parija (*Secretary*), was appointed to prepare a memorandum relating to the establishment of a National Research Council for India for being submitted to the Government of India.

LETTERS TO THE EDITOR

Interaction of Atomic Energy Levels Part II

In continuation of the work previously reported in *Current Science*,[1] the spectra of mercury and of cadmium and of their mixture have been studied by the same method as before. Some lines of the two elements have disappeared in the spectrum of the mixture, while some lines not to be seen in the spectra of the individual metals make their appearance. Other lines suffer a greater or less modification of intensity, but many lines remain unaffected. The following list contains all the lines thus modified. Brackets indicate that the change of intensity is not large.

Cadmium Lines

Weakened

[6438·47 ($5^1P_1 - 5^1D_2$)]

6329·91 ($5^1P_1 - 5^3D_1$) (absent)

6325·19 ($5^1P_1 - 5^3D_2$)

6111·52 ($6^3S_1 - 8^3P_1$) (absent)

6099·18 ($6^3S_1 - 8^3P_2$) (absent)

2881·23 ($5^3P_1 - 6^3D_1$)

2880·77 ($5^3P_1 - 6^3D_2$)

2868·26 ($5^3P_2 - 8^3S_1$)

2836·90 ($5^3P_0 - 6^3D_1$)

2775·00 ($5^3P_1 - 8^3S_1$)

2733·88 ($5^3P_0 - 8^3S_1$)

Strengthened

2677·64 ($5^3P_1 - 7^3D_2$) (new)

2660·40 ($5^3P_2 - 8^3D_3$) (new)

2602·18 ($5^3P_2 - 9^3D_3$) (new)

2288·02 ($5^1S_0 - 5^1P_1$)

2265·05 (Cd II $5s\,^2S_{1/2} - 5p\,^2P_{3/2}$) (new)

Mercury Lines

Weakened

5790·66 ($6^1P_1 - 6^1D_2$)

5789·69 ($6^1P_1 - 6^3D_1$)

5769·60 ($6^1P_1 - 6^3D_2$)

[5460·74 ($6^3P_2 - 7^3S_1$)]

3983·92 (Hg II $5d^96s^2\,^2D_{5/2} - 5d^{10}6p\,^2P_{3/2}$) (absent)

[3663·28 ($6^3P_2 - 6^1D_2$)]

[3662·88 ($6^3P_2 - 6^3D_1$)]

[3654·83 ($6^3P_2 - 6^3D_2$)]

[3650·15 ($6^3P_2 - 6^3D_3$)]

2804·46 ($6^3P_2 - 8^3D_2$)

2803·48 ($6^3P_2 - 8^3D_3$)

2698·85 ($6^3P_2 - 9^3D_3$) (absent)

2639·93 ($6^3P_2 - 10^3D_3$) (absent)

2603·15 ($6^3P_2 - 11^3D_3$) (absent)

2578·44 ($6^3P_2 - 12^3D_3$) (absent)

Strengthened

[4077·83 ($6^3P_1 - 7^1S_0$)]

2655·13 ($6^3P_1 - 7^1D_2$)

2653·68 ($6^3P_1 - 7^3D_1$)

2652·04 ($6^3P_1 - 7^3D_2$)

[2536·52 ($6^1S_1 - 6^3P_1$)]

2534·80 ($6^3P_0 - 7^3D_1$)

2464·02 ($6^3P_2 - 9^3S_1$) (new)

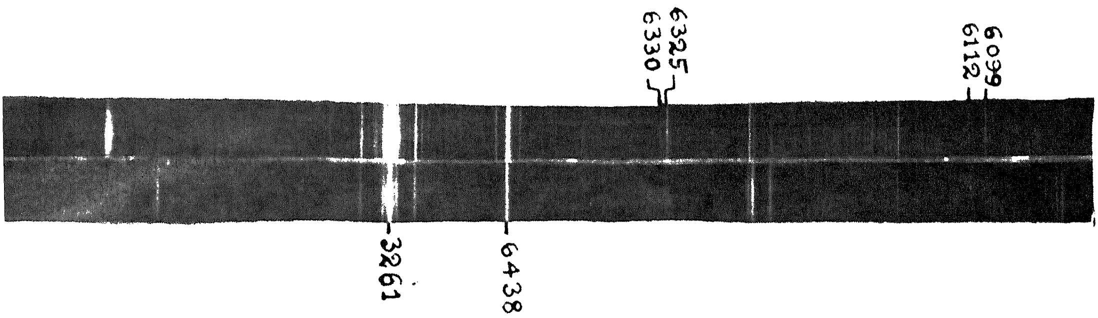


FIG. 1

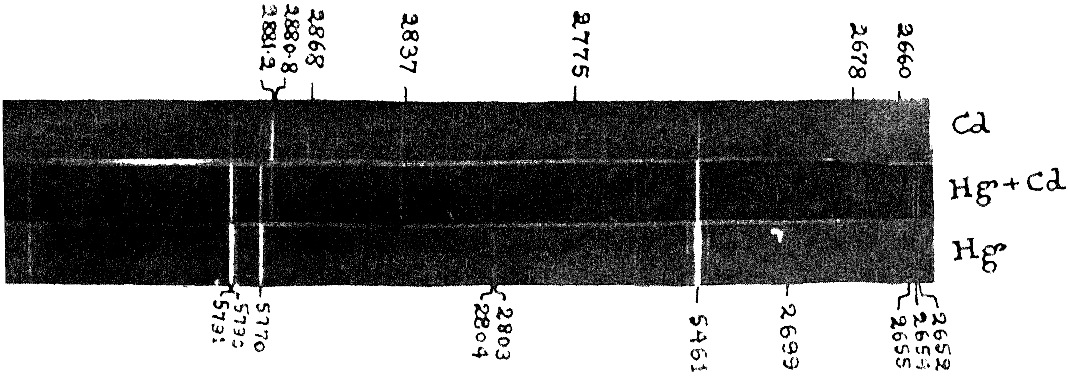


FIG. 2

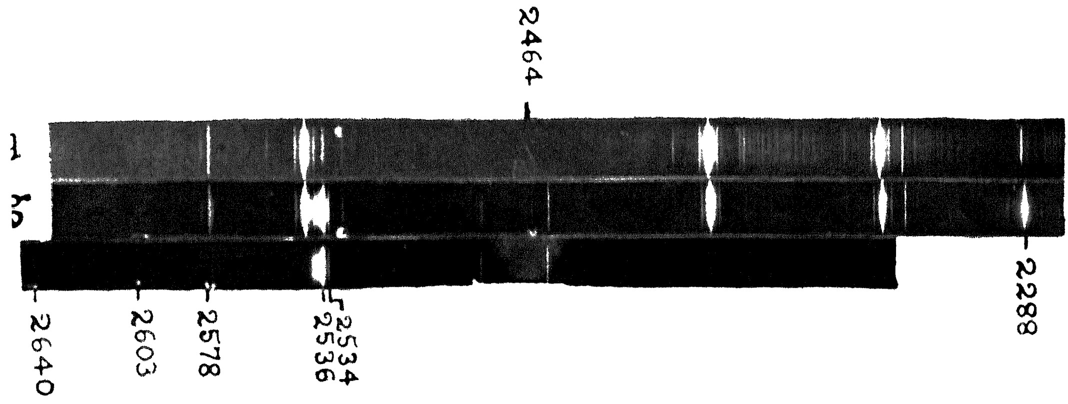
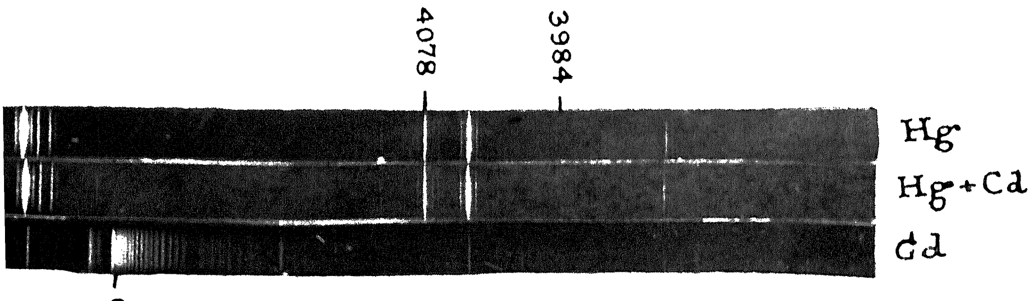


FIG. 3



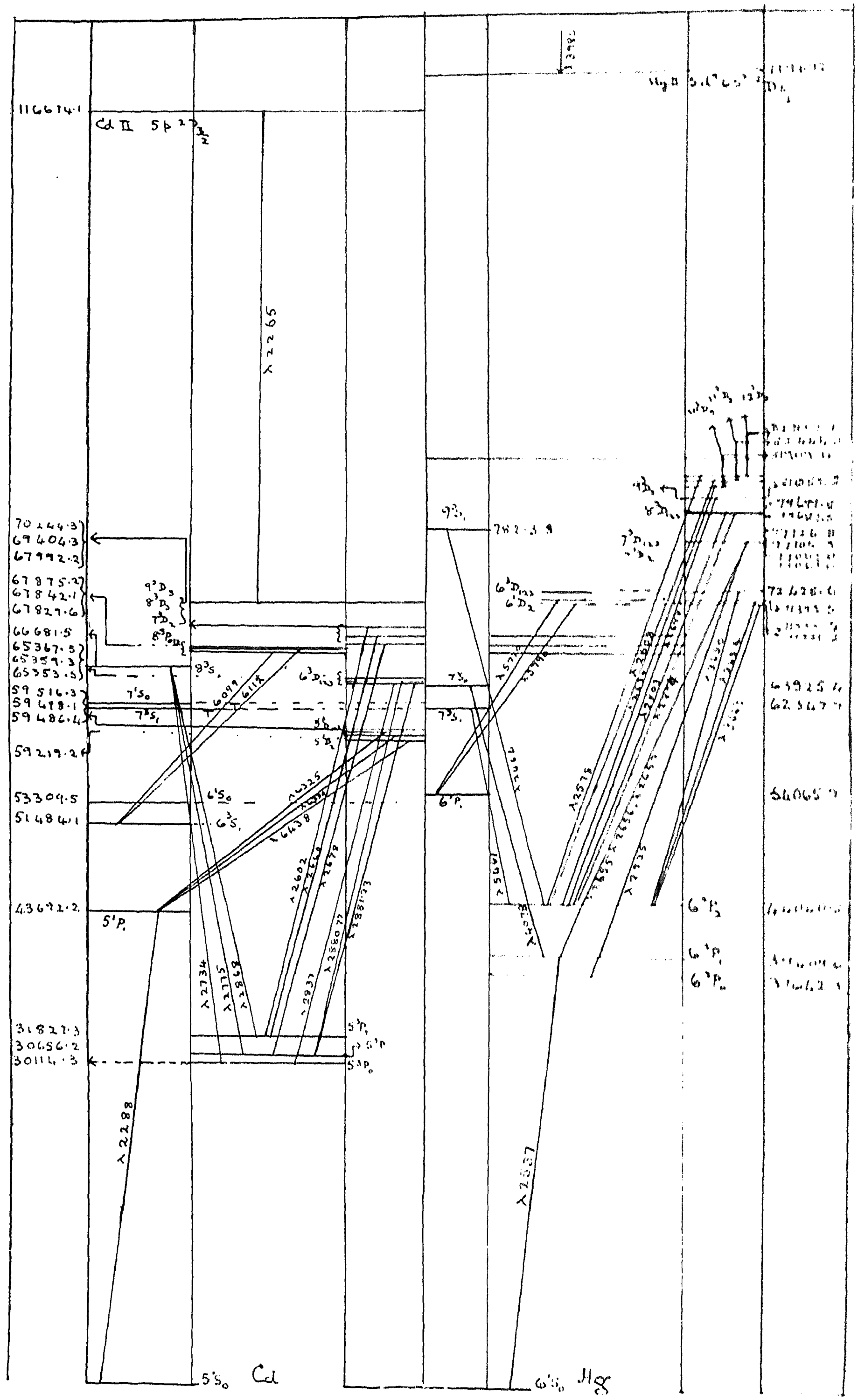

116614·1
Cd II 5p ²P3/2
λ 2265
70 244·3
69 404·3
67992·2
67 875·2
67 842·1
67829·6
66 681·5
65367·5
65359·3
65353·5
59 516·3
59 498·1
59 486·4
59 219·2
53309·5
51 484·1
43 692·2
31827·3
30656·2
30114·3
5'P₁
6'S₀
6³S₁
7'S₀
7³S₁
8³S₁
λ 2288
λ 2734
λ 2775
λ 2868
λ 2602
λ 2980·77
λ 2881·23
5'S₀ Cd
9³S₁
7³S₁
6'P₁
6³P₂
6³P₁
6³P₀
λ 2537
λ 2575
λ 2925
54065·9
6'S₀ Hg

FIG. 5

The resonance line 2537 of mercury shows complete self-reversal in mercury but no trace of reversal in the mixture. The 2540 band accompanying 2537 is present in mercury and in the mixture with cadmium, whereas it disappeared in the mixture with zinc. Similarly the ZnH bands appearing in zinc continued strong in the mixture with mercury, but the CdH bands, though present in cadmium, disappeared in the mixture of mercury and cadmium. The resonance line of zinc 3076 was weaker than 3345 in pure zinc but became stronger than the latter in the presence of mercury; on the other hand, the cadmium resonance line 3261 was stronger than 3610 in cadmium and continued to be so in the mixture.

Of the various instances of alteration of line intensity enumerated above, the strengthening of 2288 is the easiest to explain. The excitation energy of 5^1P_1 of Cd is 43692·2 cm,$^{-1}$ while the metastable 6^3P_2 state of mercury has an energy very close to this, *viz.*, 44040·2 cm.$^{-1}$. Hence the probability of the latter exciting the former is high and so 2288 is strengthened. The slight weakening of 5461 shows that some atoms are removed from the 7^3S_1 state without dropping to the 6^3P_2-level. Taking this with the fact that the Cd lines 6438 ($\nu = 15527$ cm.$^{-1}$), 6330 ($\nu = 15794$ cm.$^{-1}$) and 6325 ($\nu = 15805$ cm.$^{-1}$) are weakened, we may assume that the energy of these lines raises the Hg atom from the 7^3S_1 state to the 7^3D_2, 7^3D_1 and 7^1D_2 states which differ from 7^3S_1 by 14757·6, 14734·3 and 14713·3 cm.$^{-1}$ respectively, say, by impacts of the second kind. This will then explain the brightening of 2655, 2654, 2652 and 2534. All these lines, except 2534, involve transitions to the 6^3P_1 state, so that the population of this state is increased. Hence we should expect 2537 to be brightened, as is actually the case. The brightening of 2655, 2654, 2652 and 2534 can also be due to mercury atoms in the 6^3P_2 state (energy 44040·2 cm.$^{-1}$) being raised to the 7^3D_2, 7^3D_1 and 7^1D_2 states by interaction with the metastable 5^3P_2 state of Cd (energy 31827·3 cm.$^{-1}$). The energies of 7^3D_2, 7^3D_1 and 7^1D_2 are 77061·0, 77082·0 and 77105·3 cm.$^{-1}$ respectively, and, the sum of the energies of 6^3P_2 of Hg and 5^3P_2 of Cd being 75867·5 cm.$^{-1}$, the deficiency is within what can be supplied by thermal energy. In a similar way, the energy of 6112 ($\nu = 16358$ cm.$^{-1}$) and 6099 ($\nu = 16391$) of Cd which are weakened must have been used to raise the Hg atom in the 7^3S_1 state to the 9^3S_1 state, the difference between which is 15866·1 cm.$^{-1}$. The new appearance of 2664 is thus explained. Of the cadmium lines which are weakened, the upper state of 2881·2 and 2836·9 is 6^3D_1 of energy 65353·5 cm.$^{-1}$, that of 2880·8 is 6^3D_2 (energy 65359·3 cm^{-1}) and that of 2868·3, 2775·0 and 2733·9 is 8^3S_1 (energy 66681·5 cm.$^{-1}$). These energies are sufficiently near the excitation energy of 7^1S_0 of Hg which is 63925·4, to make it probable that the strengthening of 4078 is due to this interaction. 5791, 5790, 5770, 3663, 3654 and 3650, all of which are weakened, have $6^3D_{1,2,3}$ and 6^1D_2 as their upper levels. Their excitation energies are 71333·4, 71393·5, 71428·6 and 71330·2 cm.$^{-1}$ and these are sufficiently near 7^3D_2, 8^3D_3 and 9^3D_3 of Cd (energies 67992·5, 69404·3 and 70250 cm.$^{-1}$) to explain the new appearance of 2678, 2660 and 2602 of Cd.

The weakening of 2804, 2803, 2699, 2640, 2603, and 2578 means the depopulation of 8^3D_2, 8^3D_3, 9^3D_3, 10^3D_3, 11^3D_3 and 12^3D_3 of Hg. The excitation energies are 79687·5, 79699·8, 81082·2, 81909·0, 82444·0 and 82812·1 cm.$^{-1}$. If these energies are added to the energy of the metastable $^3P_2$ state of Cd (= 31827·3 cm.$^{-1}$) we come sufficiently near to the excitation energy of 2265 of Cd II (116674·1 cm.$^{-1}$) for the difference to be capable of being supplied by thermal energy. The excitation energy of 3984 of Hg II (119692 cm.$^{-1}$) which has disappeared is also capable of explaining the new appearance of 2265. Since the excitation energies of 8^3D_2 . . . 12^3D_3 of Hg are higher than the ionization energy of Cd, the explanation of the weakening of 2804, etc., must proceed in some such way as the above, but too much weight should not be attached to the disappearance of such weak lines as these,

Apart from explaining the observed changes of intensity, some clarification is required for the fact that no interaction has been found between other levels of Hg and Cd which are quite close to each other, *e.g.*, 6^1P_1 of Hg and 6^1S_0 of Cd, 7^3S_1 and 7^1S_0 of Hg and 7^3S_1 and 7^1S_0 of Cd, x^3P of Hg and 8^3P and 8^1P of Cd and so on. The theory of the interaction of atomic energy levels must be better developed for this to be possible. The present work is intended to provide an experimental basis for such a development. The transitions for the various wave-lengths are indicated in the level diagram appended (Fig. 5).

In conclusion it is a pleasure to record our thanks to Prof. A. Venkat Rao Telang, M.A., F.Inst.P., for his encouragement and many facilities afforded to us.

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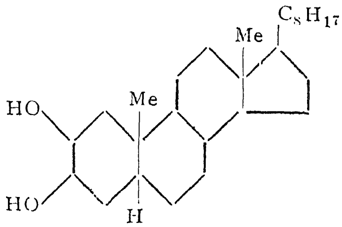
January 12, 1940.

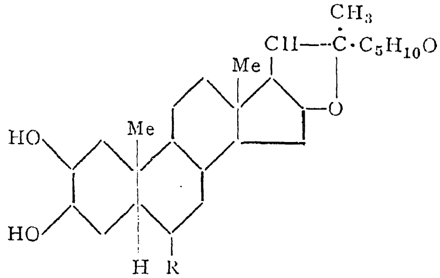
The Configurations of the C_2 and C_3 Hydroxyl Groups in Gitogenin and Digitogenin

It has been previously mentioned[1] in connection with the 2:3-dihydroxycholestanes (I) that the presence of the hydroxyl group at C_2 may not interfere with the digitonin precipitability and that of the four isomers of 2:3-dihydroxycholestanes, two, in which the C_3 hydroxyl groups are of the normal (β-) configuration, should precipitate with digitonin. This is now indirectly confirmed by the recent reports of Noller[2] and of Marker and Rohrman[3] that the 2:3-dihydroxysteroid sapogenins, gitogenin (II, R = H) and digitogenin (II, R = OH) precipitate with digitonin, contrary to what had been previously reported by Tschesche and Hagedorn.[4]

There are four theoretical possibilities of the relative configurations of the C_2 and C_3 hydroxyl groups in these sapogenins corresponding to the four stereoisomeric forms of 2:3-dihydroxycholestane[1] (of which in one the hydroxyl groups are in the *trans* and in the rest



(I)



(II)

in the *cis* positions). Basing on the report of Tschesche and Hagedorn[4] and also the behaviour of the three isomeric 2:3-dihydroxy*trans* decalins,[5] it was suggested[6] that the C_2 and C_3 hydroxyl groups in gitogenin and digitogenin are in transpositions to each other, the C_3 hydroxyl groups being of the *epi* (α-) configuration. Due to the observations of the American authors mentioned above, this suggestion is now revised.

Assuming the precipitation with digitonin to be having the same significance for the steroid sapogenins as for the sterols (Noller[2]), it is to be concluded that C_3 hydroxy group in gitogenin and digitonin is of the β-configuration—*i.e.*, it is *cis* to the C_{10} methyl group. By the other hydroxyl group at C_2, occupying the two possible positions *cis* or *trans* with reference to the C_{10} methyl group, two forms are possible in which the two hydroxyl groups (which are *cis* to each other in both forms) are unsymmetrical or symmetrical respectively about the plane of the carbon atoms 2, 3, 5 and 9. (These two forms correspond to those of B and A respectively of 2:3-dihydroxy*trans*decalin[5].) By

analogy with the behaviour of the 2:3-dihydroxy*trans*decalin of form B, we should expect the sapogenins to isomerise to the *trans* form on treatment with acid if these hydroxyl groups possessed the unsymmetrical configuration. Since this has not been observed, it may be concluded that in gitogenin and also in digitogenin the hydroxyl groups at C_3 and C_2 (which are in *cis* positions to each other) are *cis* and *trans* respectively with respect to the C_{10} methyl group.

K. GANAPATHI.

Haffkine Institute,
Parel,
Bombay,
December 28, 1939.

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Elasticity of Organo-Gels in Relation to Hysteresis in Sorption

EXPERIMENTS on hysteresis in the sorption of vapours on organic natural colloids are few in the literature. Rao, B. S.,[6] and co-workers have expressed the view that rice is essentially a colloidal system having the characteristics of a gel. This view can be extended to all other grains and plant materials. The unique colloidal behaviour of the rice grain[7] of losing the hysteresis loop initially exhibited by it, when the cereal is subjected to successive sorptions and desorptions of water vapour has already been presented. This behaviour has revealed the rôle of elasticity of the swollen grain on hysteresis in sorption. This principle receives further striking confirmation by the results obtained by conducting a series of sorptions and desorptions of water vapour, on the calcium salt of gum arabic, presented in this paper.

Calcium arabate was prepared according to the method described by Briggs.[2] Gum arabic (5% solution of Merck's C.P. Quality) was precipitated by ethyl alcohol from an acid solution containing hydrochloric acid (0·1 N.). It was reprecipitated and partially dried in vacuum to remove the alcohol. In order to remove the electrolytes, an aqueous solution of this gum was subjected to hot dialysis, till the dialysate showed no change in conductivity. The method developed by Bernhart[1] and co-workers was adapted for hot dialysis. The dialysed solution was just neutralised with the requisite amount of calcium hydroxide. The solution was evaporated on a water-bath till thin flakes of calcium arabate were obtained. The flakes were powdered and activated at 60° C. in vacuum for half an hour. The activated calcium arbate was degassed in the sorption tube for five hours in vacuum and a series of sorptions and desorptions of water vapour at 30° C. were conducted with the aid of a McBain-Bakr quartz fibre spring balance.[5] The results are shown in Fig. 1.

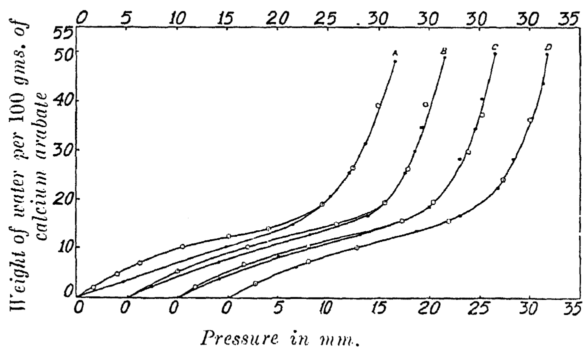

FIG. 1

A	First sorption	—•—•— and desorption	⊙—⊙—⊙	
B	Second ,,	,,	,,	,,
C	Third ,,	,,	,,	,,
D	Fourth ,,	,,	,,	,,

A period of about a fortnight was necessary for completing each cycle of sorption and desorption. In the first cycle of sorption and desorption, calcium arbate exhibits a hysteresis loop which dwindles away in the subsequent cycles and completely disappears in the fourth cycle, the sorption and the desorption curves

being perfectly coincident. This interesting behaviour of calcium arabate, analogous to that of rice grain[7] leads to the following conclusion, in accordance with the cavity concept[3] which has already been established to be a general cause[8] of hysteresis in sorption. Calcium arabate on its initial activation, has capillaries some of which are open pores and some are cavities having narrow necks. In the beginning, these cavities have rigid walls. After they are filled up, they trap the water and retain it when desorption is effected. Thus the arabate retains, for the same vapour pressure, more of water during desorption than during sorption. With progressive sorption and desorption, however, the gum swells and the walls of the cavities become more elastic. With an increase in the elasticity of the cavity wall, the cavities are less effective in trapping water. Thus after a certain stage, *i.e.*, in the fourth cycle of sorption and desorption, they have completely lost the power of trapping water, as indicated by the sorption and the desorption curves being coincident.

The hysteresis loop in the first sorption and desorption extends up to a relative humidity of 0·78. This corresponds to a maximum radius of 40·5 Å of the cavities in the sample of calcium arabate, as calculated from Lord Kelvin equation,[4,10] $ln \frac{p}{p_s} = \frac{-2\sigma v}{rRT}$, where p is the pressure at the concave surface, p_s the pressure of saturated vapour of liquid in bulk at that temperature, σ is the surface tension, v is the volume of one gram mol. of condensed liquid, r is the radius of the capillary, R the gas constant ($8{\cdot}315 \times 10^7$ ergs), T the absolute temperature, and ln represents the natural logarithm to the base e. The fact that the hysteresis loop stretches down to zero pressure, as in rice-water[7] system indicates that some of the cavities have necks of molecular dimensions. Compared with the activated rice grain, calcium arabate has much finer cavities. Some of the biggest cavities in rice, however, are of microscopic dimensions, as indicated by the peak of the hysteresis loop extending up to the saturation point.

Dhal grain (*Cajanus indicus*), a member of the dicotyledonous seeds, exhibits similar behaviour[9] of having a hysteresis loop in the first cycle of sorption and desorption which disappears in the subsequent cycles. A series of sorptions and desorptions of carbon tetrachloride vapour on the activated rice grain have shown the existence of a permanent hysteresis loop[9] which has been reproduced at the ninth sorption and desorption, whereas with water, the hysteresis loop exhibited in the first cycle of sorption and desorption has been found to disappear[7] in the third cycle.

All these observations afford a convincing proof of the view already expressed about the effect of elasticity[4] of the gel system on hysteresis in sorption. It is indeed probable, that all grains and plant materials, which become elastic by virtue of their property of swelling on the imbibition of water, exhibit no permanent hysteresis loop in the sorption of water and other solvating liquids. With nonsolvating liquids, however, there is no swelling and the porous gel retains its rigidity even after a series of sorptions and desorptions. The hysteresis loop should, therefore, remain permanent and perfectly reproducible as in rice-carbon tetrachloride system.[9] So, in all elastic gels, in the sorption of vapours of solvating liquids, as a rule, there should be no hysteresis loop. Even if there is a hysteresis loop, it should disappear after a certain number of sorptions and desorptions. Whether there is an initial hysteresis loop or not, depends upon the previous history of the gel, *e.g.*, drastic desiccation of the gel at high temperatures which may result in the production of cavities.

The investigations, *vide infra*, on a series of sorptions and desorptions of the vapours of different liquids, on a few typical organo-gels

have revealed the rôle of elasticity of organo-gels on hysteresis in sorption.

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December 27, 1939.

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The 'Tyrosinase' from *Dolichos lablab*

IN view of the recent work[1-5] on phenolases which has revealed conflicting views regarding the existence of distinctly separate enzymes for the oxidation of the mono- and dihydroxy phenols, it was of interest to purify and elucidate the nature of the "tyrosinase" present in *Dolichos lablab*. The enzyme extract was obtained by an extraction of the dried and powdered seeds with saline (5 per cent. NaCl). On removal of the salt by dialysis, the globulins of the extract were thrown down, which were subsequently filtered off. The resulting clear light brown filtrate containing most of the enzyme was saturated with ammonium sulphate, when the enzyme was completely precipitated. A further purification of this precipitate was effected by fractional precipitations with alcohol and acetone and by adsorption on calcium phosphate gel.

The enzyme preparations oxidise catechol with great ease, while the oxidation of phenol, *p*-cresol, tyrosine, pyrogallol and "dopa" does not proceed with the same vigour. The course of oxidation of these substrates has been followed manometrically by measuring the oxygen uptake in a Warburg. Through a series of preliminary trials, the conditions for obtaining a measure of the activity of the enzyme preparations, were standardised. The oxygen uptake with phenol and *p*-cresol was found to be linear (after a short initial induction period) and proportional to the concentration of the enzyme. With catechol, as reported by Wagreich and Nelson,[5, 6] the oxygen uptake falls off rapidly, presumably due to inactivation of the enzyme. But the secondary oxidation of hydroquinone or ascorbic acid through the aid of the catechol as "carrier" proceeds at a rate which is a measure of the enzyme. The rate of oxygen uptake is proportional to the concentration of carrier within narrow limits (0·01 to 0·03 mgm. in 2 c.c.).

For a comparative study of the activity of the enzyme preparations towards mono- and dihydroxy phenols, the oxygen uptake with ascorbic acid/catechol and with phenol were measured. The oxygen uptake with hydroquinone/catechol and *p*-cresol also follow closely the above. The measurements were made at pH 6·2 on 1 mgm. quantities of substrate in a final volume of 2 c.c.

The following table indicates the effect of a preliminary purification on the activity of the enzyme towards the two different sets of substrates.

It will be observed that the activity towards phenol decreases as compared to catechol, with progressive purification. The induction period with phenol becomes prolonged while the oxidation of catechol begins instantaneously in every case. The addition of minute amounts of catechol (0·02 mgm.) to the phenol practically abolishes the induction period, increases the oxygen uptake, which, however, tends to fall off instead of remaining steady. In the fractional precipitations with alcohol and acetone, no other fractions of the enzyme with a comparatively greater activity towards phenol than catechol, could be obtained. The centrifugate after adsorption was also not more active towards phenol. These results suggest that the activity towards phenol (or *p*-cresol or tyrosine) is a secondary reaction depending on the

No.	Purification stage	Total solids mgm. per c.c.	Activity in mm. min./mgm. enzyme		Ratio (A)/(B)
			Ascorbic acid/catechol (A)	Phenol (B)	
1	Initial extract precipitated with Am_2SO_4 and precipitate suspended in water and dialysed	10	0·25	0·2	1·25
2	(1) Precipitated with alcohol in the cold 30-60 per cent. and precipitate taken up in water	6	6·0	5·0	1·20
3	(2) Precipitated with acetone in the cold 33–60 per cent. and precipitate taken up in water	2	3·7	2·1	1·8
4	(3) Adsorbed on $Ca_3(PO_4)_2$ gel at pH 5·0 and eluted with M/20 Na_2HPO_4	1·0	11·0	2·5	5·6
5	Further precipitation of (4) with acetone in the cold 33–60 per cent.	0·5	20·0	1·6	12·5

presence of a subsidiary factor, in addition to the main portion of the catechol (or diphenol) oxidase. This factor gets eliminated during the purification and is partly replaceable by catechol. Work on the further purification of the enzyme is being continued.

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December 20, 1939.

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Vascular Anatomy of the Flower of *Macadamia ternifolia* F. Muell. (Proteaceæ)

SINCE the publication of an account of floral anatomy in *Macadamia ternifolia* F. Muell. sometime back[1] the writer had occasion to make a more detailed examination of the floral structure in the same plant. Some of the previous interpretations concerning the nature of the perianth traces and the morphology of the nectar-secreting disc at the base of the ovary are now found to be incorrect in certain respects. The writer is grateful to Prof. Arthur J. Eames, of Cornell University, U.S.A., who, being requested to give an opinion in the matter, very kindly pointed out the discrepancy in the earlier account.

It is stated in the paper cited above that the perianth in the modern Proteaceæ represents the whorl of calyx and that the marginal strands of the perianth segments which arise by forking of four large strands separating from the receptacular stele represent traces to a lost corolla. Such an interpretation was offered on the strength of the remarks by Joshi and Rao[2] in their work on the floral anatomy of some Nyctaginaceæ; these authors state with regard to the two sets of traces to the perianth that one method of interpreting is "that each set of traces belongs to a separate whorl of leaves and formerly in this family there were two whorls of perianth leaves, the traces of the lower set belonging to the sepals and those of the upper to the petals. At present these two sets of traces are running in the same whorl owing to the disappearance of one whorl." This interpretation is inconsistent with the detailed observations now made in *Macadamia ternifolia*. The perianth segments are strictly sepals in nature and their vascular connections are quite normal as in many other angiosperms

(Eames and MacDaniels, 1925),[3] each segment showing the usual midrib strand and two marginal strands (Fig. 5).

The origin of the midrib strand of the perianth segments is rather interesting. Corresponding to the four midrib strands of the four perianth segments there are formed as many pairs of strands separating from the receptacular stele. The members of each pair next move out upwards at the base of the flower (Figs. 3 and 4) and finally fuse with each other before actually entering a perianth segment as a large median strand (Fig. 5). In this connection Prof. A. J. Eames expresses in a personal communication: "The origin of the midrib trace of the sepal from two strands is remarkable." This point was, therefore, very critically examined and it is found that there is a distinct double origin of each midrib strand as shown clearly in Figs. 3-5 and in the Photomicrograph 1. From each midrib strand is then separated to the inside the single trace for the stamen (Figs. 1 and 5).

Regarding the nectar-secreting disc which develops as a ring-like structure at the base of the ovary, it is stated in the previous account that it is a new structure without any definite morphological status in the flower. This interpretation was based on a study of insufficient material and its exact nature could not be precisely determined. Further, it was influenced to some degree by the remarks of Brough[4] regarding the same structure in another member of the Proteaceae, *Grevillea robusta* Cunn. Brough states that "The fact that the nectar scales are, in this family, often four in number, and alternating with the perianth segments, suggested" to him "that they might constitute a reduced and modified inner whorl of floral leaves, or in other words represent the vestiges of an ancestral normal corolla", but that "There is no indication, whatsoever, of any associated vascular tissue, and consequently, no ground for interpreting the scale as the morphological equivalent of a reduced perianth." On the other hand, a very careful examination of

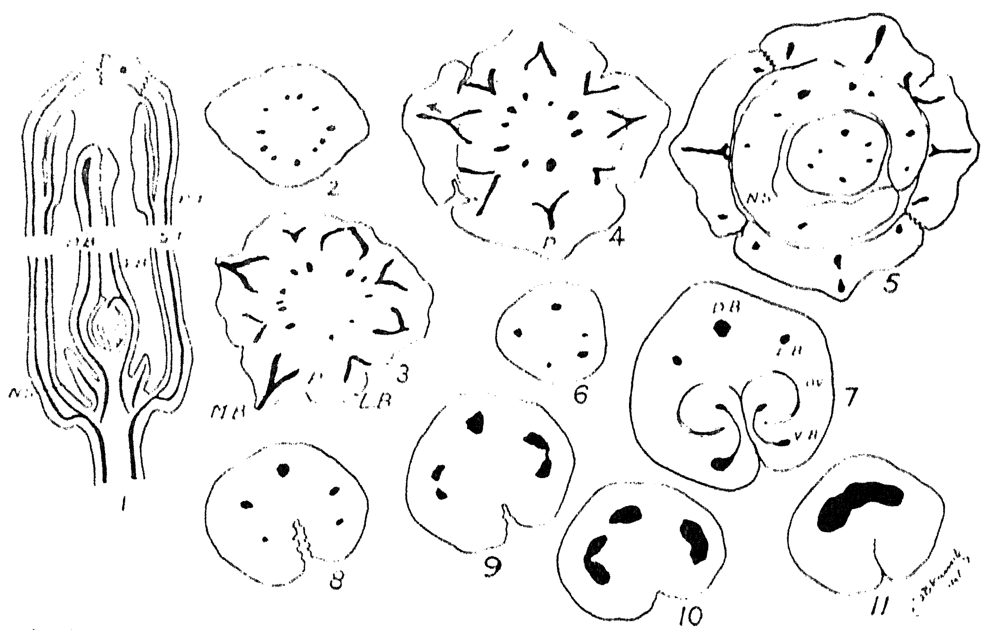

Fig. 1. Longitudinal section of flower showing the vascular connections for the various floral organs. Fig. 2. Transverse section of the base of flower. Figs. 3–5. Series of transverse sections showing the departure of traces to the perianth segments. Fig. 6. Transverse section of the base of gynoecium. Fig. 7. Transverse section of the gynoecium at the region of the ovule showing ovule trace. Figs. 8-11. Series of transverse sections of the style and stigma.

the disc as now made appears to throw definite light on its exact morphology in the flowers of *Macadamia*, which may presumably be true of the other Proteaceæ too. In the tissue of the disc there are found scattered here and there a few feebly developed vascular strands (Fig. 5), whose cell elements, however, do not seem to become fully tracheal in nature in so far as they lack the characteristic markings of the wall of a true tracheal tissue. They appear merely as strands (Fig. 1) composed of elongated cells with more and more diminished cell

PHOTOMICROGRAPH 1—showing the double origin of the midrib strand and the formation of marginal strands for the perianth segment.

contents as the disc grows older (Photomicrograph 2). These strands may, therefore, be

PHOTOMICROGRAPH 2—showing the longitudinal section of the base of flower with vascular strands in the nectar secreting disc.

reasonably inferred to constitute the remnants of a more highly developed vascular tissue in an ancestral form. It is further highly probable that the vascular elements in the disc disappear completely in some members of the Proteaceæ, as in *Grevillea robusta*. Arber[5] states that organs may often persist even though the vascular traces supplying them have disappeared completely. As Wilson and Just[6] remark, "It is undoubtedly true, that in some cases at least, what may appear to be rudimentary organs have persisted with no corresponding vascular supply; such structures may, however, be really organs which can only be interpreted by a comparative study of other and closely related forms." A good instance of this seems to be met with in *Macadamia ternifolia*. We may, therefore, rightly regard the disc as a much reduced corolla in the flowers of the modern Proteaceæ, and this suggestion is further strengthened by the fact that in the place of the disc there are sometimes seen in the family four scales alternating with the perianth segments.

It is interesting to point out here that Joshi[7] regards the disc-scale in the flowers of *Stellera chamœjasme* Linn., a member belonging to the Thymelæaceæ, as a part of a much reduced corolla. This appears to be rather significant, because the families Proteaceæ and Thymelæaceæ are regarded to be probably related to each other in some way by some systematists, as Hutchinson[8] in recent years.

After the departure of the traces to the outer floral organs the receptacular stele shrinks to form a ring of vascular tissue showing a number of strands. Of these strands all, except five large ones which supply the single carpel, gradually fade away at the summit of the receptacle. The five strands of the carpel which are from the beginning quite independent of one another, arrange themselves in the wall of the gynœcium (Fig. 7) as one dorsal, two lateral, and two marginal or ventral strands. The traces for the ovules are formed higher up in the gynœcium from the two ventral strands (Fig. 7). In *Banksia* too, another member of the

Proteaceæ, the carpel has similarly five strands derived independently from the stele of the receptacle. Such a vascular condition of the carpel is regarded by Eames[9] as probably representing a somewhat specialized case derived from an original three-trace carpel, "chiefly through branching of the midrib, and by a working back of this branching tendency to the stele."

The further behaviour of the five strands of the gynœcium in the style and stigmatic regions in *Macadamia* has already been fully described in the previous paper and some of the figures in the series of transverse sections from the base towards are reproduced here for the sake of completeness of the present account.

In conclusion the floral structure in *Macadamia ternifolia* F. Muell., may be briefly stated as follows: The flowers are probably derived from a dichlamydeous ancestry, the modern perianth representing the whorl of calyx with the usual vascular connections as in most other angiosperms and the nectar secreting disc constituting a much reduced inner whorl of floral leaves, namely, the corolla. The vascular tissues in the disc are feebly developed, or they may be entirely lost as **in** some members of the family, for instance, *Grevillea robusta.* Adnation of the whorl of stamens and perianth has occurred followed by a fusion of the two sets of traces and consequent on the reduction of the corolla. The simplicity of floral construction in *Macadamia ternifolia*, which may well be true of the other members also, as revealed by a study of vascular anatomy seems best, therefore, to be regarded as a derived condition through reduction of floral parts.

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December 27, 1939.

1. Kausik, S. B., *Proc. Ind. Acad. Sci.*, 1938, **8**, 45.
2. Joshi, A. C., and Rao, V. S., *J. Ind. Bot. Soc.*, 1934, **13**, 169.
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Serum Phosphatase in Pulmonary Tuberculosis

The serum phosphatase of normal persons and of persons affected with pulmonary tuberculosis has been determined (S. K. R.) by the method of Bodansky.[1] The serum phosphatase of persons with pulmonary tuberculosis is, on the average, higher than normal. Oral administration of 200 to 250 mgm. of vitamin C in the form of 10 g. of sun-dried *Emblica officinalis* pulp for ten days lowered the serum phosphatase content in more than 71 per cent. of pulmonary tuberculosis cases as compared with a decrease in 14 per cent. only in controls receiving no additional vitamin C in the form of *Emblica officinalis.*

Description	Phosphatase units (av.)	Description	Phosphatase units (av.) Before exp.	Phosphatase units (av.) After exp.	Remarks
Normal ..	1·63 (0·68–2·28)	Control (P.T.)	2·82 (1·56–4·96)	3·51 (1·52–5·01)	Phosphatase lowered in 14·3% cases
Pulmonary tuberculosis	3·95 (1·32–9·96)	200–250 mg. C for 10 days (P.T.)	4·53 (1·32–9·96)	2·41 (0·92–9·36)	Phosphatase lowered in 71·4% cases

Figures within brackets indicate limits.

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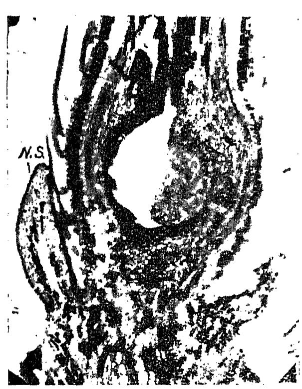

Photomicrograph 2—showing the longitudinal section of the base of flower with vascular strands in the nectar secreting disc.

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Figures within brackets indicate limits.

It is claimed that the lowered phosphatase is wholly due to the vitamin C (and/or vitamin P?) content of the *Emblica officinalis* powder which makes an improvement in the clinical condition of the P. T. patient by increased vascular resistance and other adjuvant effects. It is suggested that the determination of serum (or plasma) phosphatase be made one of the routine tests for evaluating the clinical progress of tuberculosis patients. The investigation is being continued.

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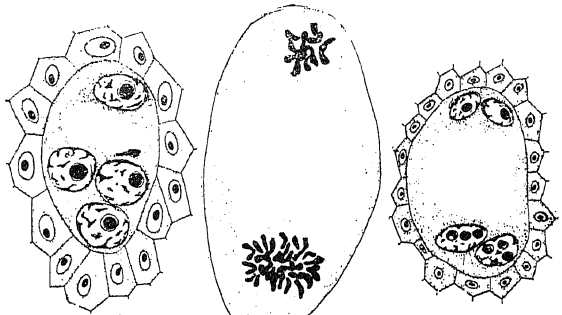
[1] *J. Biol. Chem.*, 1933, **101**, 93.

Evidence for the Fritillaria-Type of Embryo Sac in *Tamarix ericoides* Rottl.

THE writer has recently published a detailed account of the embryo-sac of *Tamarix ericoides* Rottl., and has pointed out that it takes place according to the *Fritillaria*-type. Since then some further observations have been made and the critical stage in the establishment of the *Fritillaria*-type, which was not then available has now been met with in the preparations.

Succeeding the development of the embryo-sac showing the 1 + 3 arrangement (Fig. 1) there follows the simultaneous division of all these four nuclei and the formation of two groups of chromosomes, one at the micropylar end and the other at the chalazal end. In the micropylar group twelve chromosomes which represents the reduced number can be clearly counted. In the chalazal group a much larger number which approaches thrice that found at the micropylar end is seen. This evidently means that the group of three nuclei at the chalazal end have come together so near one another that their spindle fibres have fused and the chromosomes of the three nuclei have become indistinguishably grouped together (Fig. 2). This condition has been reported by Zabban in *Myricaria germanica,* while Mauritzon and other succeeding workers, namely, Joshi and Kajale, and Puri have not observed this stage in the several species they have worked.



1 × 150 2 × 400 3 × 100

Mauritzon who described the *Adoxa*-type of development in *Tamarix tetrandra* and five other species of the same genus (*T. æstivalis, A. africana, T. gallica, T. odessana* and *T. pentandra*) has also evidently not been able to follow the entire sequence of changes that accompanies the final development of the embryo-sac. After the division is over a secondary four-nucleate embryo-sac arises which has two micropylar nuclei, each with one nucleolus, and two large chalazal nuclei each of which again has three nucleoli (Fig. 3). This establishes beyond any doubt that the development of the embryo-sac in *Tamarix ericoides* Rottl. is of the *Fritillaria*-type.

I am grateful to Dr. M. A. Sampathkumaran, M.A., Ph.D., for his encouragement and guidance in the above investigation.

Y. M. L. SHARMA.

Department of Botany,
Central College,
Bangalore,
January 12, 1940.

[1] Sharma, Y. M. L., *Ann. Bot.*, 1939, **3**, 861.

Budding in *Protosiphon botryoides* Klebs

Protosiphon botryoides grows plentifully in heavily manured Canna beds of Guptar Park, Fyzabad, in the months of October and November. In early October the oval plots of this park become carpeted with a rich green growth of

this interesting alga. In the end of November the dried up clods of clay become brick-red in colour due to extensive cyst formation.

Protosiphon botryoides was collected by the present author from fields lying fallow in Hoshiarpore district of the Punjab in October 1929 and a reduced variety of it growing on walls was described by Iyengar from Madras. The interest of the present form lies in the peculiar type of budding seen in some of the specimens. Iyengar could not observe any budding in the samples he collected from Madras and he records as follows: "The budding of the green aerial portion, which Klebs recorded from the European specimens, was never observed in the Indian alga although hundreds of specimens were examined. Nor

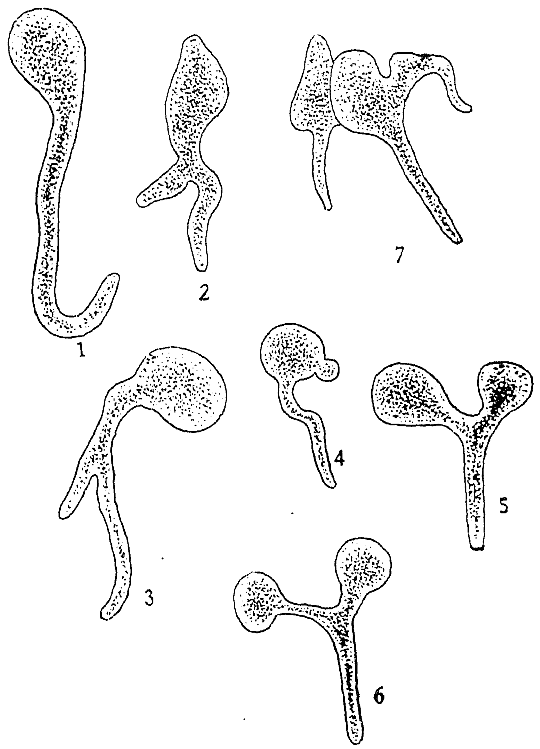


FIG. 1.—*Protosiphon botryoides* Klebs.

1. A typical plant. 2 and 3. Plants with branched rhizoidal parts. 4, 5, 6 and 7. Show different stages in budding. All × 120.

was such budding ever seen in the variety growing on the walls described below." No budding was observed in the specimens collected from Hoshiarpore in 1929.

The subaerial part of the alga is usually spherical and rhizoidal part unbranched (Fig. 1). However, in some specimens branching was seen in the rhizoidal part (Figs. 2 and 3). It was observed that in some specimens bud-like protuberances were seen arising on one side of the balloon-like subaerial part (Fig. 4). A further stage in budding was seen in some specimens in which the rhizoidal part was seen bearing two globular subaerial vesicles (Figs. 5 and 6). The parent is recognized by the greater diameter in some cases (Fig. 5), while in others it is difficult to distinguish between the parent and the bud, as both are almost of the same size (Fig. 6). Individuals thus budded off usually remain attached with the parent plant for some time (Fig. 7).

It may also be noted that during the vegetative phase of this alga, budding is an important means of reproduction, especially when it grows on heavily manured soil containing plenty of nutrient material. However, when the alga is found growing in fields which are usually not well manured, budding has quite an insignificant role in the life-cycle of the alga.

M. S. RANDHAWA.

2A, Park Road,
Allahabad,
December 8, 1939.

A Note on the Algæ Collected by James A. Murray at Karachi

JAMES A. MURRAY has mentioned a few marine algæ collected by him from Manora and Clifton at Karachi in his book on the plants of Sind.[1] Murray being the earliest scientific explorer of these plants his collection is of some importance to the algologists in our country. Amongst other plants Murray has recorded the following species: *Porphyra vulgaris* Ag.; *Fucus vesiculosus* L.; *Fucus distichus* L.; *Fucus nodosus* L.; *Laminaria digitata* Lam.; *Laminaria bulbosa* Ag.; *Laminaria saccharina* Lam.; *Chordaria flagelliformis* Ag.; *Callithamnion plumula* Lyng.; *Callithamnion corymbosum* Ag.; *Chondrus crispis* Lyng. On scanning the whole list of algæ one is surprised to find that no one of his plants has been found by the recent investigators and

in fact, they are not known to occur on this side of the globe.

So far as the author is aware Murray's collection of algæ are found both at the British Museum and the Kew Herbarium. Dr. F. Borgensen[2] of Copenhagen was rather misled by Murray's collection found at the latter place. This at least has been made clear by him in the following words: "When I heard that the British Museum also possessed a large collection of J. A. Murray's Algæ from Karachi I was of course especially interested in finding out whether the northern species were found there too. This not being the case greatly increases my doubts as to whether they really live there." etc.

As some of the plants mentioned by Murray are of economic utility I visited Karachi in 1938 to find out for myself if the species were still available there. I was sorely disappointed in my search. At the same time I inquired at the Municipal Museum where Murray was a Curator, if some of his plants could be found there. There, I saw for the first time in this country, good many marine plants exhibited. They really were old but the date and the name of the collector were not on them and still more, the specimens were not what they were labelled to be. It is difficult to believe that all these plants mentioned could have existed in the locality only three score years before and now completely exterminated.

It is a loss to science that Murray's first collection is not preserved in this country so that it could now be revised like Forsskal's algæ mentioned in *Flora Ægyptico Arabica*. However, this note would serve its humble purpose if the Government and the Universities would learn better from the past and try to preserve all the original natural history specimens in this country as a national trust.

S. C. Dixit.

Wilson College,
Bombay.

1 James A. Murray, *The Plants and Drugs of Sind*, Bombay, 1881, pp. 1–6.
2 F. Borgesen, *A List of Marine Algæ from Bombay*, pp. 4–5, *Biologiske Meddelelser*, 1935, XII, 2, Kobenhavn.

Constitution of Sulphur Nitride

The note on the above subject in the October issue of *Current Science* (p. 473), calls for a few comments. The term "resonance" must not be mistaken for alternate structures, as the authors of the above note seem to do. After quoting the idea of Arnold, Hugill, and Hutson that sulphur nitride has structure I *with* (italics mine) the corresponding resonance structures I*a* and I*b*, the authors proceed to pick out which is the correct formula! The dipole moment of S_4N_4 as measured indicates but the polarity of the superposed state of the molecule and not that of any component state.[1, 2]

Apart from this, from a purely structural point of view, (1) it is wrong to say structure I will have $\mu = 0$, as on account of the possible free rotation about the single bonds, it will have quite an appreciable moment;[3] (3) the moment of I*b* may be due to similar reasons, the contribution of $> S = S$ being practically nil as it is a homopolar bond; (3) the formula, I*a*, if redrawn with the normally accepted valency angles, will show that there are no re-entrant angles at S atoms.

M. A. Govinda Rau.

Department of Physics,
Indian Institute of Science,
Bangalore,
October 31, 1939.

1 C. K. Ingold, *Chemical Review*, 1934, **15**, 225.
2 M. A. G. Rau, *Proc. Ind. Acad. Sci.*, (A), 1936, **4**, 687,
3 ——, *Curr. Sci.*, 1934, **3**, 145.

In our note on the Constitution of Sulphur Nitride, when we assigned the structure (I*b*) to S_4N_4, we meant to say that (I*b*) was the predominant structure of the three. Regarding the actual origin of the moment and the comments of Dr. Rau, full details will be published elsewhere.

N. L. Phanilkar.
B. V. Bhide.

Chemistry Laboratory,
Sir Parashurambhau College,
Poona 2,
December 22, 1939.

Ferns of Mussoorie

[illegible] receipt of a paper on "Ferns of Mussoorie" by P. N. Mehra of the Punjab University [illegible] Dr. H. Chaudhuri [illegible] Kashyap Research Laboratory [illegible] Lahore. The author [illegible] of new species [illegible] an attempt [illegible] together in [illegible] the fern flora of the [illegible] local lists of [illegible] a great demand [illegible]

[illegible] affection of [illegible] important [illegible] A thorough knowledge [illegible] Cambridge Congress [illegible] Amsterdam Con[illegible] foremost requisite [illegible] which, are [illegible] India is found [illegible] the estimation of [illegible] India. The second requisite [illegible] of the literature, not only of the Indian but also of the other countries, dealing with the subject, because, the nomenclature of and the interpretation of species have [illegible] and are undergoing great changes with [illegible] knowledge. A third but not the least [illegible] the necessity of correlat[illegible] with the authentic collections available in a fully equipped and well recognized Herbarium. For us, in India, the Herbarium at the **Royal Botanic Garden,** [illegible] has been recognized by the Amsterdam Congress of 1935 as the chief representative [illegible] in Asia, besides the ones in China and Japan.

We have been reluctantly forced to dilate a little more than what we desired to say on this subject, as we have been observing of late, that some of the systematists have been publishing [illegible] and publications [illegible] species which [illegible] description.

We congratulate Mr. Mehra [illegible] Ferns of Mussoorie. We are also [illegible] had referred [illegible] However [illegible] of the authors [illegible] notes. Apart from [illegible] of the International Rules of Botanical Nomenclature [illegible] the publication of [illegible] new species [illegible] of a type specimen [illegible] diagnosis [illegible] sketches or photos of the type [illegible] any new species does not become valid.

Apart from the absence of this important consideration for a new name, we have also been unable to agree with the author in regarding it as a new species. The [illegible] on which the author has [illegible] new species, appear to us to [illegible] presence of scales on the [illegible] *midrib* with ovate lanceolate [illegible] *long drawn out* [illegible] P. [illegible] scales on the upper surface of the midrib are ovate [illegible] ovate, never [illegible] author says that the scales on the under surface of the fronds in the new species are [illegible] and [illegible] than in P. [illegible]

There is a very good set of collections of *P.* [illegible] (*Polypodium lineare* [illegible]) in the Herbarium at Sibpur, especially

from Mussoorie and the surrounding localities. According to all pteridologists, including Baker and Hooker, Beddome, Christensen, Ching and others, *Polypodium excavatum* belongs to a group of ferns with the fronds having naked under-surface, *i.e.*, without any persistent matted scales (*vide Hk. & Bk., Syn. Fil.*, pp. 353, 354). The author says that the scales in *P. excavatum* are fewer and ovate or ovate orbicular, etc., and never hair-pointed. In the collections at Sibpur, belonging to *P. excavatum*, we have failed to detect this scaly nature (large or small) on the under-surface of the fronds. In a few sheets, especially on the stipe near the rhizome, a few scattered scales whose number could be counted on the finger, are noticeable. In certain sheets a few scattered hair-like scales also by the side of the midrib towards the base of the stipe, like those pictured on p. 24 of Mr. Mehra's paper, are also present. As regards the habit, the author appears to generalise from observation made at one place only, which may be due to the nature of the habitat in that locality. We do not consider these points sufficient for specific differentiation. Further we know that the only Indian representative of the widely spread American fern, Pleopeltis, a group of ferns segregated from the heterogeneous Polypodia, having persistent peltate scales, with a dark centre, is the South Indian *Pleopeltis lanceolata* Kaulf. (*P. lanceolatum*). We also know that, according to R. R. Ching, the fronds in the young stages are densely covered with easily detachable scales which fall off with age. There will be no end to the creation of new species based upon such characters, which vary with age and are of no permanent nature. We are, therefore, apart from its invalidity of publication, inclined to consider this as only a particular stage of *Polypodium excavatum*.

The other point on which we wish to say a few words, is the nomenclature of some of these Polypodiums. It is true that Christensen has retained the name Polypodium. Under it, he has included several other groups as Subgenera. But when we consider the heterogeneous nature of the genus Polypodium and its huge size (in *Hk.f. & Bk. Syn. Fil.*, there are 390 species of Polypodium) we will be justified in splitting it up, on practical grounds, into smaller, easily recognisable groups with generic status to each. R. C. Ching has relegated all these Polypodia with simple lanceolate, shortly stipitate naked leaves and with the sori on a plexus of radiating veinlets and densely covered with detachable peltate scales when young, to *Lepisorus* (J. Sm.) Ching. According to this view, which we consider good, on practical grounds, some of the species listed in this paper become *Lepisorus Thunbergianus* (Klf.) Ching *P. linearis*), *L. clathratus* (Cl.) Ching and *L. excavatus* (Bory) Ching.

Further we consider the figure of *P. excavatum* too narrow for *P. excavatum* and it represents rather the linear leaves of *P. lineare* than those of *P. excavatum*.

The author's two varieties, var. *xerophytica* nov. of *P. lachnopus* and *P. microrhizoma*, are according to the author himself, plants occurring in open situations on calcareous rocky soil. They are, therefore, only edaphic variants of the same mother species and do not deserve a varietal rank.

V. NARAYANASWAMY.
K. BISWAS.

Herbarium,
Royal Botanic Garden,
Calcutta,
December 5, 1939.

REVIEWS

Lehrbuch der Theoretischen Physik. Von Prof. Dr. G. Joos. (Dritte Auflage, Leipzig), 1939. Pp. 704. Price 24 R.M.

This third edition of the well-known book on theoretical physics by Prof. Joos is a marked improvement on the old editions in subject-matter as well as manner of presentation. In making these improvements the author has throughout kept in view the aim, mentioned in the *Foreword* to the first edition, that the contents of the book have been determined by taking into consideration the needs of the experimental and technical physicist.

In the present stage of the development of theoretical physics it is easy to write a book on the subject without any physics in it! It is perhaps equally easy to go to the other extreme and present all the theory needed by the experimenter in a ready-made form without going into the actual physical significance of the theory. While one could justify the statement "An ounce of experiment is worth a ton of theory" on some grounds, it is also possible to justify the opposite statement "An ounce of theory is worth a ton of experiments" on other equally reasonable grounds. Here, as elsewhere, it is the compromise between these two extreme view-points that is at all likely to succeed as the correct method of presentation for the *understanding* of both aspects of the subject. This is the method adopted in Prof. Joos' book, and it has succeeded admirably in the elementary plane to which the author has confined himself.

The brief and clear account of nuclear physics running to about 20 pages is a welcome feature of the book, and the author has taken care to include the most recent topics like the β-decay and the neutrino hypothesis, and even the mesotron. Similarly there is a short account of the theory of ferromagnetism which is of such great practical significance and has been subject recently to intensive theoretical development. The author's aim in presenting these modern topics has been that "klare erkenntnisse bedurfen nicht vieler Worte zu ihrer Übermittlung".

To write a text-book on theoretical physics is a task of great complexity. Further, to write an elementary book which is not altogether unwieldy, and which does not omit essentially important things, appears to be an art by itself. This volume before us running to 700 pages shows how this can be done successfully. No elementary course on theoretical physics which does not prescribe Joos as a text-book or a book of reference is worth anything at all.

B. S. Madhava Rao.

Fluorescence Analysis in Ultra-Violet Light. By J. A. Radley and Julius Grant. Third Edition. (Chapman & Hall, Ltd., London), 1939. Pp. xvi + 424. Price 22/6 net.

That the authors should be called upon to publish a third edition of this book within six years of its publication, is in itself an indication of its usefulness and interest to a wide public.

Part I of the book deals with the theory and technique of the method in a simple manner; the newer developments in the production of steady sources of ultra-violet light and in the preparation of light filters have received due attention. Part II deals with "the applications of the method to a large and varied number of ramifications of pure and applied chemistry". Indeed the scope of this method of analysis appears to be amazingly wide; and in the hands of an experienced worker, the observations can lead to safe conclusions. It may be of interest to note certain typical practical applications:—

"Fish and meat show a marked change in fluorescence due to bacterial action."

"Edible and poisonous varieties of mushrooms are detectable."

"So strong is the blue fluorescence of margarine that its presence to the extent of 15% can be detected in butter."

"The preservatives, boric acid, salicylic acid, sulphur dioxide, hypochlorites can be detected when present in 10 p.p.m."

"Lubricating oils can be tested with a view to find out their relative gumming tendencies."

"A mammoth's tusk carved to depict a woman found in some pre-historic dwellings was proved by Franz to be

in fact, they are not known to occur on this side of the globe.

So far as the author is aware Murray's collection of algæ are found both at the British Museum and the Kew Herbarium. Dr. F. Borgensen[2] of Copenhagen was rather misled by Murray's collection found at the latter place. This at least has been made clear by him in the following words: "When I heard that the British Museum also possessed a large collection of J. A. Murray's Algæ from Karachi I was of course especially interested in finding out whether the northern species were found there too. This not being the case greatly increases my doubts as to whether they really live there." etc.

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S. C. Dixit.

Wilson College,
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[1] James A. Murray, *The Plants and Drugs of Sind*, Bombay, 1881, pp. 1–6.
[2] F. Borgesen, *A List of Marine Algæ from Bombay*, pp. 4–5, *Biologiske Meddelelser*, 1935, XII, 2, Kobenhavn.

Constitution of Sulphur Nitride

The note on the above subject in the October issue of *Current Science* (p. 473), calls for a few comments. The term "resonance" must not be mistaken for alternate structures, as the authors of the above note seem to do. After quoting the idea of Arnold, Hugill, and Hutson that sulphur nitride has structure I *with* (italics mine) the corresponding resonance structures I*a* and I*b*, the authors proceed to pick out which is the correct formula! The dipole moment of S_4N_4 as measured indicates but the polarity of the superposed state of the molecule and not that of any component state.[1,2]

Apart from this, from a purely structural point of view, (1) it is wrong to say structure I will have $\mu = 0$, as on account of the possible free rotation about the single bonds, it will have quite an appreciable moment;[3] (3) the moment of I*b* may be due to similar reasons, the contribution of $> S = S$ being practically nil as it is a homopolar bond; (3) the formula, I*a*, if redrawn with the normally accepted valency angles, will show that there are no re-entrant angles at S atoms.

M. A. Govinda Rau.

Department of Physics,
Indian Institute of Science,
Bangalore,
October 31, 1939.

[1] C. K. Ingold, *Chemical Review*, 1934, **15**, 225.
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In our note on the Constitution of Sulphur Nitride, when we assigned the structure (I*b*) to S_4N_4, we meant to say that (I*b*) was the predominant structure of the three. Regarding the actual origin of the moment and the comments of Dr. Rau, full details will be published elsewhere.

N. L. Phanilkar.
B. V. Bhide.

Chemistry Laboratory,
Sir Parashurambhau College,
Poona 2,
December 22, 1939.

Ferns of Mussoorie

We are in receipt of a paper on "Ferns of Mussoorie" by P. N. Mehra of the Punjab University, with a *Foreword* by Dr. H. Chowdhuri, Director of the **Kashyap Research Laboratory** of the Punjab University, Lahore. The author has listed 94 species including one new species and two new varieties of ferns. Such an attempt on the part of the author, to bring together in one easily accessible form, the fern flora of the locality is indeed laudable. Such local lists of special groups of plants are now in great demand. We welcome more of such local lists from systematists all over India in order to enrich our knowledge of the Indian flora.

It is our earnest desire to invite attention of such would-be authors to many important points that have to be taken into account in the preparation of such works. A thorough knowledge of the international rules of botanical nomenclature, as amended by the Cambridge Congress of 1930 and accepted by the Amsterdam Congress of 1935, is the first and foremost requisite for any systematist in India, without which, any work on Systematic Botany in India is bound to suffer considerably in the estimation of botanists outside India. The second requisite is complete knowledge of the literature, not only of the Indian but also of the other countries, dealing with the subject, because, the nomenclature of and the interpretation of species have undergone and are undergoing great changes with the increase of our knowledge. A third but not the least important, is the necessity of correlating the local collections with the authentic collections available in a fully equipped and well recognised Herbarium. For us, in India, the Herbarium at the **Royal Botanic Garden**, Sibpur, has been recognised by the Amsterdam Congress of 1935 as the chief representative botanical institution in Asia, besides the ones in China and Japan.

We have been reluctantly forced to dilate a little more than what we desired to say on this subject, as we have been observing of late, that some of the systematists have been publishing new species without any regard to the rules governing such publications. They have thus been wasting their time and energy on publishing new species which will have no value before the scientific world and we are afraid, in the long run, are likely to be discarded and forgotten.

We congratulate Mr. Mehra, the author of the *Ferns of Mussoorie.* We are also grateful for his kind reference to us in this connection. However, we have to dissociate ourselves from some of the author's conclusions as discussed below. Apart from some nomenclatorial defects, especially in the genus Polypodium, we regret to notice the utter disregard, rather to the ignorance of the author, of the International Rules of Botanical Nomenclature, in connection with the publication of his new species *Polypodium Kashyapii* nov. sp. This name is invalid and will have no status in science as it is not in conformity with the articles Nos. 18, 19, 37 and 38 of these rules, which provide, to say briefly, (1) to the existence in a well recognised institution of a type specimen on which this new species is based and (2) particularly to a latin diagnosis, followed, if possible, with proper sketches or photos of the type, without which any new species does not become valid.

Apart from the absence of this important desideratum for a new name, we have also been unable to agree with the author in regarding it as a new species. The "*certain important characters*" on which the author has based this new species, appear to us to be chiefly the "*presence of scales on the under-surface of the midrib with ovate lacerate margin and apex long drawn out, hair-like and thrown into wavy curves* (in *P. excavatum,* scales on the under-surface of the midrib are ovate or orbicular-ovate, never hair-pointed)." Secondly, the author says that the scales on the under-surface of the fronds in the new species are more numerous and hair-pointed than in *P. excavatum.*

There is a very good set of collections of *P. excavatum* (*Polypodium lineare* var. β simplex) in the Herbarium at Sibpur, especially

the untouched work of a carver of the glacial period."

"It is claimed that polluted water containing proteins and ammonia can be readily distinguished from pure water."

"In a fatal case of calendine poisoning in which the chemical and the botanical examination gave negative results, ultra-violet light produced a marked yellow fluorescence in the intestines which was similar to that produced by the juice of calendine."

The method has yielded exceedingly interesting results in legal and criminological work relating to the identification of inks, finger-prints, stains, seals, adhesives, erased writing, forged signatures, repairs and over-painting of old pictures, drugs in body fluids, etc.

The book deals with these practical applications in an exhaustive fashion. The references have been carefully shifted and are up to date. The authors, however, very rightly point out that though "in the early days the results were so encouraging that this method was hailed as rapid, accurate .... and for many purposes, indispensable to the analyst .... maturer consideration showed that the accuracy was limited and the reproducibility dependent on strict standardisation of working conditions."

With this caution, this book may be recommended for use not only to all analytical chemists, but also to pure scientists who are interested in the interaction of light and matter.

J. C. Ghosh.

A Text-Book of Heat. By H. S. Allen, M.A., D.Sc., F.R.S., and R. S. Maxwell, M.A., B.Sc. Part II. (Macmillan & Co., Ltd.). Pp. 531–848. Price 10*sh.* 6*d.*

It is with intense pleasure that I have read the II Part of this beautiful book on Heat. It starts with the Laws of Thermodynamics and after dealing with convection and radiation, proceeds to treat of statistical methods and the quantum theory. The treatment of the First Law of Thermodynamics is lucid and adequate, and calls for no special remarks. Chapter XXIX begins to explain the Second Law—admittedly more difficult—and deals with the pioneer work of Sadi Carnot, whose argument was described by Joseph Larmor (1918) as "perhaps the most original in physical science, whether as regards simple abstract power or in respect of grasp of essential practical principles". It is well stated that whilst the first law asserts the equivalence of heat and energy the second is concerned with the 'method' by which heat can be transformed into mechanical work, and the 'direction' in which natural processes occur (p. 603).

The law is given in its negative form, and since it is proverbially difficult to prove a negative, we have to be satisfied with the assurance that the law is in harmony with our general experience (p. 604). Later on, however (p. 628), Clausius is quoted, stating the law in its positive form in the famous words: "The entropy of the world tends to a maximum", which are equivalent to Lord Kelvin's dictum: "The available energy of the world is tending towards zero" (p. 631). Now, since the available energy in the universe has not yet reached zero, one is led to conclude that either the world must have had a beginning, or its energy must be infinite, or an outsider must have interfered with the cosmic processes. But if the world's available energy is infinite, it is somewhat difficult to understand how it can tend to zero. Therefore, excluding the third hypothesis, one would say that the world is not eternal. The authors seem to have been afraid of these metaphysical depths, and have tried to save themselves by subscribing to G. N. Lewis's assertion that increase of entropy "corresponds merely to a loss of information with regard to a state of a system and is thus a purely subjective concept" (p. 815). These are dangerous words, and one wonders what would remain of physical science, if they were followed to their last conclusions. Apparently less sweeping is R. A. Millikan's remark that from the second law we cannot deduce the 'heat-death' of the universe (and its corresponding beginning), for it is not legitimate to make a sweeping generalisation from man's experience on the surface of the earth to the universe in all its parts (p. 815). Hence one would say that there are parts of the universe where, what Oswald calls perpetual motion of the second kind is not impossible (*cf.* Planck's *Treatise on Thermodynamics*, transl. by Alex Ogg, 1927, Part III, pp. 79 and ff.).

The authors state very clearly Boltzmann's relation between entropy and probability, and explain that Boltzmann's constant is to be regarded 'universal', *i.e.*, having the

same value for any system that may be chosen, no matter whether one chooses a terrestrial or a cosmic system. But if we accept Millikan's remarks, we confess we feel less confident about this asserted universality, as well as to the universality of Planck's constant and many recent conclusions of Astrophysics.

In some parts of the book one notices a very close connection with G. Castelfranchi's *Modern Physics*. (I have at my disposal only the IV Italian Edition of 1934. Hoepli, Milano.) *Cfr.* for instance the authors' treatment of Debye's Theory of Specific Heat (p. 779) and Castelfranchi's treatment. The similarity, however, may simply be due to the fact that both have made use of Debye's original *Memoir*. Yet one regrets that while Castelfranchi deals at sufficient length (pp. 430 and ff.) with the quantisation of rotary motion as suggested by Bjorrum and Schwarzschild, which throws some light on the behaviour of specific heats, our authors are silent about it.

But, in spite of these criticisms, one must end with a note of admiration for the clarity, painstaking diligence and accuracy with which the authors have acquitted themselves. Their task was not easy. They have done it well. Nothing need be said on the get-up of the book, which reaches the excellence which is usual with Macmillan & Co.

D. FERROLI, S.J.

An Introduction to Chemistry. By A. H. B. Bishop and G. H. Locket, Oxford. (Clarendon Press), 1939.

In writing this book the authors have attempted to meet an insistent demand for a sound introduction to Chemistry, and have succeeded most admirably. A text-book for high schools must be brief, clear and cheap, and the present introduction certainly satisfies the first two tests, and probably the third as well. The matter is well set out, the diagrams are neat, the plates are fine and the charts present a good bird's-eye view of the matter. To select a few points for special praise: The essentials of Dalton's contribution to the building up of Chemistry are clearly stated, and the point where his theory stops short is indicated (pp. 76–79). The various natural processes by which nitrogen in air is brought into combination with other elements are well described and the importance of these processes is explained (pp. 152–59). The interest and activity of the students is stimulated. *Cfr.* for instance, the questions on the action of nitric acid on metals (p. 146).

The Clarendon Press has done its work very well indeed.

D. FERROLI, S.J.

Quantitative Zoology—Numerical Concepts and Methods in the Study of Recent and Fossil Animals. By G. G. Simpson and Anne Roe. First Edition. (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C. 2), 1939. Pp. 414. Price $4.

Broadly speaking, the general Zoologist normally exhibits a natural dislike to the use of mathematical methods involving the application of complicated formulæ. The authors of this interesting book have made an earnest attempt to kindle interest in the use of statistical methods in the hope that zoologists may not 'lose sight of the purpose of his study'. Throughout the book emphasis is laid on methodology of zoology than on mathematical statistics. This volume will be of considerable help in zoological laboratories where extensive numerical data are available for study.

The volume is well got-up and we recommend the book to all zoologists.

A. S. R.

An Introduction to the Vertebrates. By L. A. Adams. Second Edition. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1938. Pp. 479. Price 17/6 net.

The progress of zoological knowledge in all its specialised branches has taken such enormous and rapid strides in recent years that the sphere of zoological research has considerably enlarged. Recent advances in Embryology, Palæontology and Cytology have thrown considerable light on the problem of elucidating genetic relationships and any attempt to present a comprehensive picture of animal life from a comparative standpoint is likely to meet with greater success and scientific precision in the light of these recent advances in knowledge.

In various Universities, both in India and abroad, schools of Comparative Anatomy and Embryology have been established and it is essential for higher zoological studies, to have a background of Comparative Anatomy of animals—a knowledge to be checked and

verified in the light of Embryological, Palæontological and Cytological studies.

In the wake of such remarkable progress there have appeared excellent treatises on Comparative Anatomy of Vertebrates and Invertebrates. However, there are very few books which present the subject-matter in a manner suited to the needs of a beginner in Zoology. Adams has, therefore, rendered a signal service to the students of Zoology by bringing out the book under review.

The book under review is divided into three parts. The first part gives an outline of the characteristics on which the modern system of classification of Chordates is based. This part is fairly comprehensive and gives a clear outline of the leading characters with typical examples.

The author devotes the second part of the book for a detailed description of the different systems of organs from a comparative view-point.

In part three, the author deals with the different classes of Vertebrates and gives an analysis of the anatomy and specialised characters under each class.

An interesting feature of the book is the resume which we find at the end of each chapter and the glossary at the end of the book which, we are sure, are valuable aids to the students of Zoology.

The book is well illustrated with a large number of line drawings and the get-up is very good. We have no hesitation in recommending the book to all students of Zoology.

A. N. R.

Tetrapod Reptiles of Ceylon. By P. E. P. Deraniyagala. (Colombo Museum, Ceylon), 1939. Pp. XXIX + 412 with 24 plates, 137 text-figs. and 62 tables. Price Rs. 10.

Under the auspices of the *Ceylon Journal of Science*, the first volume of the Tetrapod Reptiles of Ceylon is just published and we need hardly say that herpetologists will welcome it as a most outstanding contribution to our knowledge. The author, Mr. P. E. P. Deraniyagala has been engaged in the study of reptiles of the Island for a long time and his researches have been published from time to time in the *Ceylon Journal of Science* and in the book under review, a large part of the matter and figures are from his original papers.

In the part devoted to Introduction, the author deals chiefly with local herpetology, zoogeography, definition of reptilia, economics and classification, while in the latter part, the orders Testudinata (comprising Athecoidea and Thecophoroidea) and Emydosauria are detailed. Among the Testudinate chelonians, the genera Dermochelys, Lepidochelys, Caretta, Eretmochelys, Chelonia, Melanochelys, Testudo and Lissemys and among the Crocodiles, the genera Crocodylus and Oopholis are represented in Ceylon. Exhaustive descriptions of colour, pholidosis, osteology, food, secondary sexual characters, reproduction and some developmental stages of Testudinates are given. Out of the chelonians only the rare circumtropical Dermochelys is the athecate form, of which we knew so little till now. The animal shows certain features of primitive nature, combining at the same time, some aquatic adaptations. Of the former the lizardlike scaly covering of the young, archaic skull and pelvis, osteodermal corselet and ridges of the adult are prominent, while the streamlined body with terminal limbs, the absence of claws and the presence of web would characterise the latter. Two loggerhead turtles, Lepidochelys and Caretta occur in Ceylon and the former genus was thought to be cospecific for a long time with the Atlantic Caretta and it was first shown by the author recently that they differed considerably osteologically. In Carettidæ, the second pair of ribs is covered by the second pair of costal scutes and in Cheloniidæ, it is the first pair of costal scutes that covers. The Ceylon form is now differentiated as *C. caretta gigas* from its Atlantic congener *C. caretta caretta*. The breeding range of chelonians appears to be identical with the range of Coral growth. While some stages of the development of Lepidochelys are described, nothing is known of Caretta. Among the enemies of turtle's eggs, mention is made of monitor lizards, wild boar, dogs, leopard and man while the young fall a prey to cats, gulls, herons and crows. The hawks bill (Eretmochelys) is important because of its valuable scutes,—the "tortoise-shell" and is therefore commercially exploited. In this, the second costal scute covers three costal plates. The green turtle (*Chelonia mydas*) is prized exceedingly because it affords appetising curry. This is the only marine turtle where the young has a white plastron as in the majority of scuteless aquatic forms. Amongst others, a very interesting variation is recorded where a single adult was

scuteless and smooth-skinned. The burrow-dwelling Melanochelys exhibits variations in the corselet shape. There are two subspecies, *M. trijuga thermalis* and *M. t. parkeri* sub. sp. nov. Like the former subspecies, *t. parkeri* is also essentially a terrestrial form. Among the land tortoises, Testudo (Geochelone) is most striking by its black and yellow stellate patterns. "Its shape possibly prevents carnivores obtaining sufficient purchase for their jaws to crack this protection and also serves to store a considerable amount of peritoneal fluid which apparently assists the animal to withstand the rigors of prolonged drought, which does not cause any appreciable mortality in this species." Two races of this are represented in Ceylon. In many adults the quadrate and jugal have fused in the skull to form a great part of the zygoma and sometimes a contact between prevomer and parasphenoid appears. This tortoise buries her eggs and probably revisits them. Lissemys, the soft terrapin is monotypic with 3 or 4 subspecies, of which *L. punctata granosa* is native to Ceylon. The Indian specimens of Lissemys is indistinguishable from the Ceylon forms except in the possession of a somewhat smaller entoplastral callosity and a tendency for the corselet to ossify less rapidly than in the latter.

The two representatives of Emydosauria in Ceylon are *Crocodylus palustris kimbula* and *Oopholis porosus,* the latter of which was brigaded under Crocodylus for a long time. It is noted that the Osteodermal armature would form a more stable character of taxonomic importance. The Indian Crocodile is separated from the Ceylon swamp Crocodile and is called *C. palustris palustris.* This lives "usually if not always above the limits of salt water". The author remarks that the Indian Crocodile avoids man, but this is not always true, for man-eaters are however reported. The eustarine Oopholis is definitely a man-eater. Some stages of the development of these Crocodiles are reported and it is noted that the reproduction of Oopholis discloses embryonic phases of considerable taxonomic importance.

In dealing with the cranial bones, the author remarks that in Testudinata, postfrontals are absent and labels in his figures (17, 58, 69, 95) a bone as "postorbital" which other authors have considered to be a postfrontal. How exactly this author has come to adopt this nomenclature, it is difficult to say. At any rate in a recent book on Vertebrate skull, the chelonian bone referred to above is designated as "postfrontal". Moreover, an interparietal is also recorded in Crocodile. The choanal opening on the ventral aspect of the Crocodilian skull (p. 311, p. 330) is not indicated.

As regards the figures, by way of criticism we need only remark that it is with great difficulty we could read the magnification (fig. 26, p. 58) and labellings in some (fig. 24, p. 54; 58, p. 145; 116 (b), p. 307) and we hope these will be set right in the next edition.

Apart from these, the book is so crammed with information that no herpetologist could afford to be without one and rightly does Prof. J. Gardiner point out that "To the Zoologist this monograph will be a pleasure enabling him to dip deep in his search for law in correlation of structures and habits while the naturalist will gain all he desires". While congratulating the author, we have no hesitation in recommending it to every student of Zoology. L. S. R.

Study on the Legal Position of the Illegitimate Child. (Series of the *League of Nations* Publications IV.—Social Questions, IV, 6, Geneva), 1939. Pp. 27.

Whatever the League of Nations might or might not have achieved in the field of the political life of humanity, it has certainly rendered meritorious service in the cause of the solution of many outstanding social problems, both in the matter of creating right sort of public opinion by offering the reading public detailed information regarding the nature and solution of such problems in the different nations of the world as well as in more directly using its prestige in moving various governments to take definite measures. Of these social problems, those connected with children, naturally claim our peculiar attention. The volume before us is concerned with one of the problems concerning children. In most societies, there are large groups of persons towards whom, the society has assumed rather cruel attitude. Illegitimate children are, perhaps, the worst and the most undeserved sufferers from this attitude. The work under review gives an historical outline of the social and legal aspects of illegitimacy and then presents the contemporary legal position of the illegitimate child and its claims against its father and mother. Further, we are told,

how official documents in various countries have been tried to be reproduced without indicating illegitimacy. We are also told what is being done regarding guardianship of such children. Protection of mothers of such children is a relevant topic as it affects the health and well-being of these children and is specially treated in one chapter. Finally, a large amount of statistical information regarding the percentage of births in different countries and infant mortality rates among illegitimate children is summarised and also presented in the appendix.

An illegitimate child may be described as one born or probably conceived out of wedlock. Such a child may be born to an unmarried woman or to a widow, to a concubine or to a prostitute. The last category of illegitimate children may be left out of consideration both because there are many special circumstances as well as because the number is likely to be small. Illegitimate children born to concubines have always been treated by society with a little more consideration than other illegitimate children. It seems that the various disabilities, social and legal, against illegitimate children are intended to preserve the sanctity of the marriage tie; but in practice it is clear that the social attitude towards such children gave a sort of a licence to the male for extra-marital sex-intercourse with impunity. If such attitude protected the marital tie any time, to-day, at least, when we find that in some countries illegitimate births constitute 50 to 70 per cent. of all births and in many countries they constitute 20 to 30 per cent., it can hardly be said to have any influence on marriage tie.

That illegitimate children have a very bad time of it from their very birth—nay, even in the pre-natal condition—is clear from the high infant mortality rate, higher by 50–100 per cent. than the infant mortality rate among the other children. And this when the progress of legislation and provision of communal care on behalf of illegitimate children has gone so far that the present position is summarised in the book under review in the following words: "In many countries, the position of illegitimate children is coming to resemble more and more closely that of legitimate children." To [illegible]ten the effects of the social stigma attached to illegitimacy, legitimation is the procedure allowed and adopted in many countries; maintenance rights are guaranteed in most and retention of the child with its mother is attempted in many countries. Nevertheless the circumstances of illegitimacy are such that in a number of countries it is found necessary to appoint official guardians for such children and even to place them in families. This shows that in these countries, and even in others, the distinction between the legitimate and illegitimate children remains marked though the actual conditions of living are ameliorated. The problem, it appears to the reviewer, is not a problem merely of amelioration but one that requires a radical treatment.

The actual number of illegitimate children being born every year must be very large indeed and the enormity of the problem would have been more poignantly brought to the notice of the reading public if these absolute figures were presented. In one of the previous publications of the same organization we read that in Germany alone in the year 1930 there were as many as six lacs of illegitimate children under communal care. The annual placements of illegitimate children in various countries would have enabled us to understand the extent to which the social attitude towards them is changing but the figures are nowhere given in the book. The procedure adopted in this book of presenting the material under various categories is not conducive to a proper understanding of the problem and the authors of the book themselves are at a loss to understand the causes of the varying rates of illegitimacy in different countries. If it is borne in mind that even the concept of illegitimacy is not uniform in all the countries, it will be readily admitted that the older procedure of presenting the material by countries rather than by these categories is decidedly better. The annual number of legitimations taking place in each country, if presented, would further enhance the understanding of the problem. In short, the reviewer is sorry to see that though much of the material is valuable there is no attempt to present an organic picture with a view to help radical understanding of the problem.

G. S. Ghurye.

THE CENTRAL BOARD OF IRRIGATION IN INDIA

THE *Annual Report* (Technical) of the **Central Board of Irrigation**, India, 1937–38, is a highly instructive publication, giving in outline, the various lines of investigation in connection with irrigation problems that are being tackled at the different hydraulic laboratories in India. The *Report* shows that no new research station has been opened during the course of the year under review. The existing stations are:—

1. *Central Research Station at Poona.*
2. *Punjab Research Station at Lahore.*
3. *Bombay Research Station at Poona.*
4. *United Provinces Research Station at Lucknow.*
5. *Sind Research Station at Karachi.*

The work carried out by these Research Stations cover a wide range of subjects and the discussions provided by the periodic meetings of the workers in these fields are both refreshing and instructive. The interchange of ideas between scientists and engineers which the meetings of the **Central Board of Irrigation** promote, has got one great advantage, in that they give to the scientists a practical outlook and to the engineers a scientific bent of mind.

In going through the various *Annual Reports* of the Central Board for the last few years of its existence, one is struck by the fact that more and more attempts are being made to tackle problems of flood and river control by means of scale model works. The *Central Station* at Poona has been carrying out these experiments for the last few years. In the year under review experiments in river models have also been instituted by the *Punjab Irrigation Research Institute at Mallikpur River Model Station.* These models were two of a series of experiments carried out in connection with the Haveli Project. The river models specially for alluvial rivers are in the early stage of their development and it will require careful and patient study by scientists and engineers to make them yield useful quantitative information for future guidance. The construction, manipulation and interpretation of two dimensional models such as that of a weir section for scour downstream or for position of the standing wave are comparatively simple and have been more or less standardised. The experimental results can be safely interpreted as their peculiarities and limitations are well known. For such three dimensional models as those of falls for bed and side scour, the construction, manipulation and interpretation are more difficult, though with the accumulation of more data, the interpretation of these results are becoming easier and reliable. But for river models the main difficulty is the correct reproduction of the movement of silt both on the bed and in suspension. For Northern India rivers, this difficulty is not so acute as the silts here are more or less incoherent sand and their quantities are not very great. But rivers in Bengal, Bihar, Assam and Orissa bring in huge quantities of silt and their qualities, specially those of the rivers that fall in the Gangetic Delta are colloidal. If this fundamental difference between the silt carried by the two systems of rivers in India, those of Northern India and those of the Gangetic Delta is realised, then it will become easy for the scientists and the engineers who deal with models and utilise their results to practical ends, to understand that the results derived from experiments on Northern India rivers will not apply directly to the rivers in the Deltaic regions. This difficulty is already being felt by engineers in Sind who have, up till now, tried to apply Lacey to a system of canals that carry quite an appreciable proportion of very fine colloidal clay in the bed and in suspension. In Sind a number of canals designed on Lacey had silted up badly and this was only to be expected as Lacey is supposed to hold good for canals which carry incoherent alluvial sands on the bed. Thus the application of any theory or equation derived for Northern India river conditions to the deltaic rivers of Bengal, Madras or Sind is bound to lead to costly failures. Similarly, the experience gained from the working of scale models of rivers of Northern India will not be directly applicable to rivers in Bengal or Madras.

Central Research Station, Poona.—This station has in its programme a long list of model experiments mostly in river training. The summaries show only one experiment on silt exclusion and another on falls. Among the river models there is mention of a model of the River Ganges at Hardinge Bridge. The informations supplied in the summaries are too meagre to enable the reader to form any clear idea about the

details of these experiments. One wonders if the effect of colloidal silt which is so prevalent in the river Ganges has been taken account of in the model.

Punjab Irrigation Research Institute, Lahore.—The Institute deals with almost all aspects of irrigation, from river training to reclamation of alkali soils by molasses. The poor results obtained with molasses in the Punjab as compared with the very satisfactory results obtained in the United Provinces make one wonder if the two types of alkali soils were the same in both the Provinces. It appears that an extensive series of model experiments on tube wells had been carried out in the Institute. The results, although indicated only briefly, appear to be highly instructive.

Bombay Research Station, Poona.—This Station has been mainly busy with waterlogging and drainage problems in the sugarcane areas of the Deccan Canals. Experiments on reclamation have also been carried out.

United Provinces Research Station at Lucknow.—This Station has now got a small flume for carrying out experiments in two dimensional models such as scour below falls. A number of models on different scales had been experimented upon. The silting of Sarda Canals Main Line and the control of silt entry at the head by means of regulation had been the subject of another investigation at this Station. The methods of sampling suspended silt from the river and the canal adopted in this experiment do not appear to be satisfactory. The authors are requested to see that these samples are representative and reliable.

Sind Research Station at Karachi.—It appears that this Station has increased its activities in the direction of model experiments mainly on falls and scour below falls. They are more or less on the standard lines as carried out in other stations. Lacey's Silt Theory received some attention here also but as was pointed out before, it did not lead to any useful conclusion.

In the agenda for the eighth meeting of the Research Committee of the Central Board of Irrigation held in Simla from the 5th to the 9th July 1939, there are a number of interesting items discussed.

One of these was the establishment of a Central Research Station for Irrigation. The arguments that had been advanced for or against the establishment of such a Station were many. But one point seems to have been missed by most of the speakers that irrigation and river conditions are different in different parts of India and as had been pointed out before the results obtained in Northern Indian conditions will, in most cases, not be directly applicable to deltaic conditions in Bengal or Madras. Under these circumstances it appears regional Research Stations will be more suited to Indian conditions than a Central one.

OBITUARIES

P. V. MAYURANATHAN
(1893–1939)

MR. P. V. MAYURANATHAN, who died of heart failure on December 1, 1939, was born on March 4, 1893 not far from Palghat, where he was educated till he passed his Intermediate examination. He then entered Presidency College, Madras, where he studied botany under Prof. Fyson, taking his B.A. degree in 1918. After teachching for a time in the Venkatagiri Raja's School, Nellore, he joined the staff of the Government Museum, Madras, in August 1920, taking charge of the Botanical, Geological, Anthropological and Economic Sections, the Anthropological Section being separated later under its own Curator.

In view of the multifarious duties imposed upon its Curator, it is not surprising that the Botanical Section had come to be badly in need of reorganisation. The first necessity was the building up of a reserve herbarium collection on which to draw for exhibition purposes, work on which he entered with enthusiasm and continued till his death. Special attention was naturally paid to local plants, resulting in his preparing in conjunction with Mr. Barnes, of the Madras Christian College, *The Flowering Plants of Madras City and its Immediate Neighbourhood,* published as a Madras Museum Bulletin in 1929.

Owing to the difficulty of dealing with succulent plants from herbarium specimens only, a collection of living specimens of the Indian species of *Caralluma* was made and an account of them was published by Mr. Mayuranathan and myself in 1931. This led him to attempt a similar study of the succulent Euphorbias of India on

which he was still engaged at the time of his death, progress being dependent on their slower rate of growth. He was also much interested in the histories of introduced weeds and other plants, to the study of which his most noteworthy contribution is a paper on *The Original Home of the Cocoanut* based on allusions in Sanskrit literature and Indian tradition as well as on botanical evidence. This was published in the *Journal of the Bombay Natural History Society* in 1938.

The need to deal effectively in the Museum with the major ecological aspects of South Indian botany necessitated the preparation of a classification of the principal types of South Indian vegetation. This he began in collaboration with me about a couple of years ago. The extensive knowledge he had acquired during his various collecting expeditions formed the basis of this work. A scheme of classification was formulated and submitted to several other botanists for criticism, since it presents problems in which the widest collaboration is likely to be helpful. Its main lines seem to meet with general acceptance, but some details need modifying and this has yet to be done. His untimely death is a great loss.

F. H. G.

V. N. RANGANATHA RAO, L.Ag.

By the sudden death of Mr. V. N. Ranganatha Rao, L.Ag., Economic Botanist, on the 2nd December 1939 after a brief illness, the Mysore Agricultural Department lost a very devoted and successful plant-breeder. The late Mr. V. N. Ranganatha Rao comes of a family which has rendered meritorious services to Mysore. He was the nephew of Mr. Vijendra Rao, Chief Secretary to Dewan, Sir K. Seshadri Iyer. He had his agricultural education in the Nagpur Agricultural College and his training in plant-breeding under Dr. R. J. D. Graham, formerly Economic Botanist, Central Provinces, now Professor of Botany at the University of St. Andrews. He was also a pupil of Mr. R. J. Allen, C.I.E., now Commissioner of Agriculture, Baroda. Mr. Ranganatha Rao had the greatest admiration for these two professors and up to the last day he was in correspondence with Dr. Graham who had a high regard for his old student.

Mr. V. N. Ranganatha Rao spent most of his service in plant-breeding work on cottons in Mysore. The results of his work are of far-reaching benefit. He has evolved several strains of Asiatic cottons for the black cotton soil area of nearly 70,000 acres in the Chitaldrug District. Of these (*Herbaceum* 190) better known as H. 190 is the best. It is a cross between *Gossypium herbaceum* and *Gossypium arboreum*. Its cultivation is extending fast as it has a high yield, a ginning percentage of 30, a staple length of almost 1 inch and a spinning capacity of over 30's warp counts and a silky feel. Other strains evolved by him for the black cotton soil area which are under statistical tests are Strain 19 and Nadam-like. These are also gaining in popularity with the raiyats. To drive out of cultivation the short staple *Bokda* cotton which was seeking a habitation in Chitaldrug on account of its high ginning percentage, he evolved a cross between *Gossypium Cernum* and *Gossypium obtusifolium* (Nadam). Though somewhat wanting in silkiness his *Cernum-Nadam* crosses are heavy yielders with medium staple, a very high ginning percentage of 37 and spinning capacity of 25's warp counts. These are found useful on account of wilt resistance inherited from the *Cernum* parent and very clean for picking.

In evolving new strains of *hirsutums* Mr. Rao has also rendered meritorius service. The scope for cultivation of New World Cottons in the red sandy loams of the Maidan Districts in Mysore is very great. Mr. Rao obtained a good cross between Mysore Doddahatti (acclimatised Upland cotton known to the trade as Banavar cotton) and a tree cotton answering the description of a Peruvian. This cross, M.A. II, with a ginning percentage of 30, spinning capacity of 25 to 30's warp counts and a staple length of 7/8 inch is a most prolific yielder under Mysore conditions of all the New World Cottons grown in India. Individual plants with over 100 bolls are not uncommon. He was engaged during the last three years in evolving an Asiatic cotton with wilt resistance and a high ginning percentage. His crosses now in row tests are H. 190 × Cernum Nadam 4–5 and Strain 19 × Cernum Nadam 4–5. He has also made new crosses to further increase the lint length and ginning percentage of M.A. II which has a great future in Mysore.

Mr. V. N. Ranganatha Rao's death has deprived the Mysore Agricultural Department of a very able plant-breeder who has rendered meritorious service to his State.

CENTENARIES

Baker, George (1540–1600)

GEORGE BAKER, an English surgeon, was born in 1540. He was a member of the Barber Surgeon's Company and was elected its master in 1597. He had considerable practice in London and was the family physician of the Earl of Oxford.

His Publications

His first book, the *Composition or making of the most excellent precious oil called oleum magistrale and the third book of Galen; a method of curing wounds and of the errors of surgeons* saw a second edition in 1599. His *Antidotarie of select medicine* was published in 1579.

Advocacy of the Mother-Tongue

Baker was an enthusiastic defender of the use of the mother-tongue for writing books on learned subjects. He translated many treatises from Latin. He advocated free translation. "If it were not permitted to translate but word for word, then I say, away with all translations".

Technical Terms

At the same time he insisted on the adoption of Latin technical terms, a fact which must be of value to the controversy that now prevails in our land over the "coining" of technical terms in the mother-tongue. "As for the names of the simples, I thought it good to write them as they were."

Walter, Thomas (1740–1789)

THOMAS WALTER, an early American botanist, was born in Hampshire, England, in 1740. He was a man of considerable education. As a young man he emigrated to South Carolina and lived throughout the revolutionary period and its turbulent internecine local warfare the life of a gentleman farmer on the banks of the Santee River.

Flora of Caroline

Throughout his short life, botany was his absorbing avocation. It has been stated that it was his "devotion to the cause of science (that) led him to the wilds of Carolina". It explains his assiduous study of the flora of Carolina, his painstaking analysis of a majority of the species sought out, his laborious preparation of an erudite flora of the region and the formation of a botanical garden upon his estate.

Flora Caroliniana

Walter's *Flora* (1788) is a volume of 263 pages, describing more than 1,000 species distributed among 435 genera. More than 200 of the species and 32 of the genera were described as new. It was based upon studies of specimens collected within a radius of fifty miles from his plantation. The nomenclature follows the binomial system.

Walter Herbarium

It was John Fraser that published the *Flora*. Fraser carried to England not only the manuscript of the *Flora* but also the Walter Herbarium. The herbarium remained in the hands of the Fraser family till 1849, when it was presented to the Linneen Society of London. In 1863 it was purchased by the Natural History Section of the British Museum for 15 shillings.

Walter died at his home, January 17, 1789.

Haygarth, John (1740–1822)

JOHN HAYGARTH, an English physician, was born at Garsdate, Yorkshire, in 1740. He graduated M.B. at Cambridge in 1766 and immediately thereafter became physician to the Chester Infirmary. In 1798 he retired from this occupation and established practice at Bath.

First Advocate of Isolation Hospitals

Haygarth devoted considerable thought to fevers and was one of the first to distinguish them by their periods of incubation. In a paper entitled *Observations on the population and diseases of Chester in* 1774, published in the "*Philosophical transactions*" of 1778 he advocated the removal of persons seized with fever to separate fever-wards, spacious and dry. His rules for such fever-wards and for preventing the spread of infection in private houses were of a pioneer nature.

Advocates Inoculation

In 1784, that is, even before Jenner's discovery of vaccination, he published *An enquiry how to prevent smallpox* and in 1793 he published in two volumes *A sketch of a plan to exterminate the causal smallpox, and to introduce general inoculation.*

His Publications

Haygarth was a prolific writer; he wrote many other books and contributed several papers to scientific journals. His *Synopsis pharmacopœiæ Londoniensis* (1810) and his tract *On the imagination as a cause and as a cure of disorders of the body* (1880) are of particular interest.

Haygarth died at Bath, June 10, 1822.

Cleland, James (1770–1840)

JAMES CLELAND, a Scottish statistician, was a native of Glasgow. He began life as a cabinet-maker and became superintendent of public works in London. His name is of interest to-day as that of one who was the first official Census Commissioner in the United Kingdom. In 1819 he took the first census of Glasgow and repeated the work in 1821 and 1831. This gave him an intimate knowledge of Glasgow and led to his writing several books on the city. The two of them which are of historical interest to a student of statistics are the *Enumeration of the inhabitants of Glasgow* (1832) and the *Historical account of bills of mortality and the probability of human life in Glasgow and other large towns* (1836).

S. R. Ranganathan.

ASTRONOMICAL NOTES

Planets during February 1940.—During the last week of February and the first week of March 1940, the five brightest major planets visible with the naked eye, will be well placed for observation in the evening sky towards the west of the meridian and will lie along the ecliptic within 40° of each other. Both Mercury and Venus can be seen low down in the west about sunset; the former reaches greatest elongation from the sun (18° 9′ E) on February 28 and will appear at that time as a star somewhat reddish in colour and slightly brighter than magnitude zero. Venus continues to move slowly eastward increasing its apparent distance from the sun and will be a conspicuous object in the western sky in the evenings. On February 20, there will be an interesting conjunction of the planet with Jupiter, the two being just over a degree apart at the time. Another conjunction that can be observed with interest will be that of Mars with Saturn on February 13. During the month, the moon will be in conjunction with planets as follows: Venus, February 11; Jupiter, February 12; Mars and Saturn, February 14; and Uranus, February 15.

Comets.—Periodic Comet Faye was re-discovered by Jeffers at the Lick Observatory on November 3, 1939; the object is reported to have been faint (about the 16th mag.) and diffuse with a small nucleus. The last apparition was in 1932, the period being 7·4 years. The comet is due to pass perihelion on April 23, 1940. Information has also been received (U.A.I. Circ. 798) of the discovery of a new comet by Friend at Harvard on November 4, 1939. The comet was, at the time, in the constellation Herculis, and moving in a south-easterly direction. A parabolic orbit has been computed by Maxwell and Grosh which shows that the object passed perihelion on November 6. The comet appears to have become as bright as the 8th magnitude on November 10.

A Recurrent Nova.—The star U Scorpii was discovered to be invariable by Pogson at Madras on May 20, 1863. Subsequent observations showed that the star was without doubt, a nova. Recently Mrs. Helen L. Thomas has examined the star on 1508 photographs taken at Harvard between 1891 and 1939, and finds (U.I.A. Circ. 802) that the nova was at maximum (magnitude 8·8) on May 12, 1906 and again on June 22, 1936 when its magnitude was 8·8. During the intervals between maxima the star appears to have been fainter than the 17th magnitude.

T. P. B.

MAGNETIC NOTES FOR DECEMBER 1939

THE magnetic conditions during the month of December 1939 were slightly more disturbed than those during the previous month. There were 3 days of *Moderate* disturbance (international character 2), and 18 of slight disturbance (character 1). Quiet days numbered 10 during the month.

Dates of the month	Quiet days	Disturbed days	
		Slight	Moderate
December 1939	2, 4, 14, 17 18, 19, 25, 29, 30, 31	1, 3, 5, 6, 8–13, 15, 16, 20, 22, 23, 24, 26, 28	7, 21, 27.

Seventh was the most disturbed day during the month and 18th the quietest. The above table shows the distribution of days of different characters during the month.

Only one moderate storm was recorded at about 20½ hours G.M.T., on the 6th December as against a moderate storm during December of last year. The mean monthly character for December 1939 as determined at Bombay is 0·77 as against 0·97 for December 1938.

M. R. RANGASWAMI.

The Observatory,
Colaba, Bombay,
January 8, 1940.

SCIENCE NOTES AND NEWS

Mother and Child Combinations of Blood Groups and Blood Types in Calcutta.—A paper relating to the study of blood groups was read at the ordinary meeting of the *Royal Asiatic Society of Bengal*, held on Monday, January 1, by Dr. Eileen W. E. MacFarlane. The author has examined bloods from 252 matching pairs of mothers and babies. "Among these 127 were homospecific and 125 were heterospecific. There is no significant difference in frequency of premature births nor in weight at birth between these two groups. Agglutination time of agglutinin B in cord blood is similar to that in adults but for A it is almost twice as long. Only about one-third of the infants have demonstrable agglutinins at birth. Sub-group A., is found in between 2% and 3% only of Indians in Calcutta. One hundred matching pairs of mothers and babies were typed for M, MN and N. Among them 56 were homotypic and 44 heterotypic. No exceptions to the expected possible combinations of mother-child blood types or blood groups were found. The proportions of the blood types were found to be of the same order as reported for Calcutta by previous workers, with somewhat more of MN and less of type M. The Calcutta Muslims examined resemble in their blood group proportions the up-country Khatris and not the rural Bengali Muslims."

* * *

"Anastomoses between the Rectal and Uterine Views forming a connection between the Somatic and portal venous system in the Recto-uterine pouch," E. G. WERMUTH, *Jour. Anat.*, 1939.—In this important contribution, the author has given a description of the various anastomoses between the uterus and the rectum. These anastomoses between the portal and somatic venous systems were hitherto unknown. The significance of these anastomoses, in normal and pathological conditions, is discussed with special reference to the spread of infection from the uterus and parametrium towards the portal vein. It is suggested that in portal congestion these anastomoses are of greater importance than the circumanal anastomoses.

* * *

Fumigation of Rat Burrows as an Anti-Plague Measure.—Health Bulletin No. 21 (By Lt.-Col. W. J. Webster, M.C., I.M.S.; Manager of Publications, New Delhi, Second Edition, 1939, Price 2*as.* or 3*d.*) gives full details for conducting fumigation of rat burrows by hydrocyanic acid gas which is now recognised as the fumigant of choice as far as the lethal effect on rats and fleas is concerned. Experiments have been carried out in the Cumbum Valley in the Madras Presidency and also at Bombay and Lahore under the auspices of the *Indian Research Fund Association*, the Travancore Durbar and the Bombay and Punjab Governments and it has become evident that "such products as Calcid, Cyanogas 'A' dust and Cymag are powerful lethal agents for rats and rat fleas and that they can be successfully applied to rat burrows and that they are, therefore, valuable weapons in the fight against plague." "The work in Madras Presidency indicates that to maintain a steady low level of rat-population in villages fumigation should be repeated at least once in three months. It is suggested that if this were continued over a period of three years there might be a prospect of eradicating plague from endemic foci." The bulletin gives valuable information on the treatment of cyanide poisoning, chemical tests for the detection of hydrocyanic acid, etc.

* * *

International Trade in Certain Raw Materials and Foodstuffs, 1938.—A new volume entitled *International Trade in Certain Raw Materials and Foodstuffs by Countries of Origin and Consumption*, 1938 (Ser. L.o.N.P., 1939, II. A.22, 178 pp., 6/-), which is the fourth of its kind, has just been published by the Economic Intelligence Service of the *League of Nations*. It gives an account of the movement from one country to another of the commodities dealt with.

This volume contains provisional statistics for 1938 as well as revised and completed statistics for 1936 and 1937 relating to 38 commodities. These commodities include wheat, sugar, rubber, wood in various forms, hides, wool, cotton, silk, iron and steel, copper and motor spirit. The number of importing countries covered by the various tables is 125, as compared with 42 in the first volume. The statistics are thus practically world-wide, the 125 countries dealt with representing 98% of the total world trade.

The object of this volume is to show the sources from which countries do in reality obtain their raw materials and foodstuffs. The trade returns published by many countries fail to furnish this information or they indicate some intermediate country from which the goods have been sold or consigned and not the country from which they originated.

* * *

Methods for the Detection of Toxic Gases in Industry.—Four new leaflets in the series describing methods for determining low concentrations of dangerous gases which may occur in the atmosphere in industrial works have now been published by H.M. Stationery Office for the Department of Scientific and Industrial Research.

(1) Leaflet No. 8 describes a method whereby concentrations of *Phosgene* down to 1 part in 1,000,000 may be quickly estimated by drawing a sample of the atmosphere through a test paper and comparing any stain so obtained with a standard colour chart. (2) Leaflet No. 9 describes a method whereby concentrations of *Arsine* down to 1 part in 250,000 may be quickly estimated by drawing the atmosphere under test through a test paper and comparing any

stain so obtained with a standard colour chart. (3) Leaflet No. 10 describes a method whereby concentrations of *Chlorine* down to 1 part in 1,000,000 may be quickly estimated by drawing samples of the atmosphere through a bubbler containing a solution of a suitable chemical and comparing the depth of colour developed with a series of standard colours. (4) Leaflet No. 11 describes a method whereby concentrations of *Aniline Vapour* ranging from 1 part in 5,000 to 1 part in 200,000 may be quickly estimated by a refinement of the bleaching powder test, which has been made quantitative by comparing the colours obtained at known concentrations with a series of standard colours prepared from a dye.

A pamphlet describing the complete series of gases and vapours to be covered is obtainable on application to the Secretary, Department of Scientific and Industrial Research, Teddington, Middlesex.

* * *

Wood and Charcoal as Fuel for Vehicles.—A contribution to the literature on alternative fuels for vehicles has been issued by the *National Research Council of Canada* (Ottawa, 1939, pp. 23, price 25 cents) under the title "Wood and Charcoal as Fuel for Vehicles". This mimeographed publication contains a list of recent articles on this subject that have appeared in English, French, German and Italian books and periodicals, and gives brief accounts of their contents. The articles reviewed deal with test results, industrial performance and design of equipment, and show the present economic status of vehicles driven by gas from wood and charcoal.

It is pointed out in the publication that France has about 4,400 of these vehicles, Germany and Italy about 2,000 each, England very few. The use of such vehicles in Germany and Italy will be restricted by Germany's status as an importer of wood, and the inability of Italy to produce sufficient charcoal to drive more than 6,000 vehicles. Italy and France both have regulations aimed at increasing the number of wood-gas-burning vehicles.

* * *

Handbook of Empire Timbers is a publication, compiled by the *Forest Products Research Laboratory* of the Department of Scientific and Industrial Research. It contains up-to-date information on the properties, uses, and supplies of nearly 100 timbers of Empire origin that are now being offered in the home markets, and gives strength values, saw specifications, and kiln schedules appropriate to the different timbers dealt with. Much of the information has accrued since the Empire Marketing Board issued a Handbook with the same title in 1932. The pamphlet is priced 3*sh.* 9*d.* (post free) and can be had from H.M. Stationery Office, London, W.C. 2.

* * *

The Rothamsted Experimental Station Report, 1938.—The yearly account of the activities of the Rothamsted Experimental Station is addressed to two sections of the agricultural readers: those mainly interested in farming the land or advising in direct practical problems, and the scientific specialists whose highly technical and often rather intangible researches will form the basis for the practical advances of the future. For farmers the main field covered is crop production including manuring, cultivation and soil improvement, and plant disease caused by insect, fungus, and virus agents. The section dealing with a large body of data on wheat-growing, particularly in relation to the growth of consecutive crops of wheat on the same land, is of great value at the present time. The effects of manures and of previous system of cropping are summarised, and the existing knowledge on the control of Take-all disease, one of the most serious menaces in intensive wheat cultivation, is set out. A further pressing problem in a period of exhaustive cropping will be the maintenance of organic matter in the soil, and preliminary experiments on the use of surplus straw and of prepared dust-bin refuse from the towns are reported. The section dealing with the action of fertilisers contains a summary of the work carried out by the Rothamsted staff and their collaboration at outside centres in the past seventeen years. This work covers a wide range of crops and soils and is always associated with soil analysis in order to examine the value of various chemical methods proposed for the prediction of manurial requirements. In the Statistical Department methods of field experimentation and the treatment of the results are being further developed with a view of linking together high precision and economy of work in the field. A study has been made of the handling of agricultural data obtained by survey or questionnaire methods, this is in effect the systematisation of a large body of experience as distinct from the interpretation of numerical data derived from an experiment. The report contains a series of short summaries covering the current work of the laboratory departments, and includes abstracts of the 97 scientific and technical papers published during the year.

* * *

Jute Grading Experiments.—With a view to train jute growers in selling their produce in graded form, an interesting experiment is now being carried out by the *Indian Central Jute Committee* at Kendupatna, Cuttack (Orissa). Over 300 growers have joined a Co-operative Jute Sales Society, set up by the Development Department of the Government of Orissa and financed by the *Indian Central Jute Committee.* Instructions are given to grower-members in the principles of jute grading, by demonstrating the methods of assorting and the qualities that go to make up each work. The growers are evincing keen interest.

* * *

Coal Mining in India, 1938.—A record output of coal and a record number of persons employed in coal mining coupled with a small general increase in the wages paid in practically all the coal-fields, and high prices for coal at the beginning of the year, followed by a decline towards the end, are some of the main features of the mining industry in India, to which attention is drawn in the *Annual*

Report of the Chief Inspector of Mines in India for 1938, just published.

The output of coal in 1938 was over 25,250,000 tons of a declared value of Rs. 9,50,00,000 representing an increase in the output of a little less than 3,000,000 tons as compared with 1937, and an increase in value of Rs. 2,50,00,000. There were increases in output in the Jharia, Raniganj, Karanpura, Pench Valley and Assam coal-fields and decreases in the Bokaro and Giridih ones. The number of coal mines worked was 665, and the number of metalliferous (including stones, etc.) mines at work was 1,288 in the year.

Despatches of coal amounted to over 21,000,000 tons. In addition, nearly 1,500,000 tons were consumed on the collieries. The quantity of coal used for coking at the collieries was nearly 1,500,000 tons and 901,000 tons of soft coke and 104,000 tons of hard coke were made.

Coal exports amounted to nearly 2,250,000 tons, as compared with over 1,750,000 tons in 1937.

There was a decrease of about 34,000 tons in the output of manganese ore, the figures of production being 766,000 tons, valued at about Rs. 1,25,00,000, as compared with 800,000 tons valued at about Rs. 2,75,000 less in 1937. Output of iron ore also declined from 1,587,000 tons, valued at Rs. 27,50,000 in 1937 to 1,421,000 tons valued at Rs. 27,00,000.

* * *

Ulla Grass for Paper-making.—Investigations on the utilisation of *Ulla* grass (*Anthistiria gigantea*), found in abundance in the United Provinces, for the production of wrapping and packing papers, have been completed at the *Forest Research Institute*, Dehra Dun. These investigations indicate the possibility of manufacturing, from *Ulla* grass, packing and wrapping papers which will approach in quality, the imported imitation *kraft* papers and which will be superior to the brown wrappings imported into or manufactured in this country. The development of both large- and small-scale industries and the rise in the economic standards in the country point to an increasing demand for packing and wrapping papers of the *kraft quality*.—(*"Indian Forester,"* January 1940, pp. 47.)

* * *

The 75,000-pound **Antarctic Snow Cruiser** devised by Dr. Poulter and owned by the Research Foundation of the Armour Institute of Technology, is now on its way to the South Pole. Rear Admiral Richard E. Byrd is in command of the Cruiser and this is the third time that **Messrs. Bausch & Lomb** has been called upon to supply much of the optical equipment.

The cruiser is equipped with bunks, galleys, laboratories, machineshop and dark room and will carry a plane on its back, thus providing a movable base for the operation of field parties. The research programme laid out for the scientific members, according to a press note issued from Rochester, include: "Geomagnetic studies, astronomic observations, a renewed attack on unknown sectors of Antarctica, detailed surveys, meteorological observations, radio tests, metabolism studies, seismic prospecting, biological and zoological collecting, and geology, will occupy the time of some twenty scientists and their aides. The expedition has had the aid of a group of 30 scientists of the *National Academy of Sciences* in planning the programme for the United States Antarctic service.

"Spurred by the increasing number of claimants to slices of the Antarctic and its future possibilities as an aerial, meteorological and observational base, the United States Government has voted funds to make a thorough survey of this territory and a comprehensive study of its resources. The American claims which are undisputed will add a domain vaster than Alaska, afford protection for our whaling interests, and give us an opportunity to establish observatories for long-range forecasting of weather.

"Coal resources, second only to those in the United States, together with oil, copper, nickel and tin, are believed to await the development of Antarctica.

"Only 575 nautical miles separate the tip of South America from Palmer Land in the Antarctic, an easy plane flight, lending point to our extension of the Monroe Doctrine clear to the pole."

* * *

South Indian Science Association, Bangalore.—The Annual General Body Meeting of the Society was held at the Central College, on November 25, 1939. The following were elected members of the Managing Committee for the year 1940:—Dr. B. Sanjiva Rao (*President*), Dr. K. S. Gururaja Doss (*Treasurer*), Dr. M. N. Ramaswamy (*Secretary*), Mr. H. S. Venkataramiah (*Joint Secretary*), Mr. B. H. Iyer, Mr. B. H. Krishna, Dr. P. Krishna Rao, Prof. L. Rama Rao, Dr. S. Subba Rao and Prof. A. V. Telang.

* * *

The Ninth Annual Session of the **National Academy of Sciences** was held at Allahabad on 13–14 January 1940. H.E. Sir Maurice Hallett, the Governor of the United Provinces, who is the patron of the Academy, inaugurated the session.

Sir Shah Mohumud Sulaiman was re-elected President for the year 1940.

The Education Minister's Gold Medal was awarded to Dr. Mohammad Abdul Tamid Siddiqui, Professor of Anatomy, King George's Medical College, Lucknow, in consideration of his paper on "Geneto-urinary System of the Indian Ground Squirrel".

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Mr. J. B. Ross was elected President of the **Mining, Geological and Metallurgical Institute of India** for 1939–40 at the annual general meeting of the Institute held at Calcutta on January 12. Mr. J. J. Ghandy, Mr. E. S. Pinfold and Rao Bahadur D. D. Thacker were elected Vice-

Presidents and Dr. A. L. Coulson, Honorary Secretary.

The Government of India Prize of Rs. 500 was awarded to Mr. A. Wilson Haig for his paper on "Coal Carbonization and some of Its By-Products".

* * *

National Institute of Sciences of India.—At the annual meeting of the Institute held at Madras on 2nd January, Bret.-Colonel R. N. Chopra, C.I.E., M.A., SC.D., F.R.C.P., Director, School of Tropical Medicine, Calcutta, was re-elected President of the Institute for the year 1940. Sir U. N. Brahmachari and Dr. A. M. Heron were elected Vice-Presidents. The other Office-bearers are Dr. B. S. Guha (*Treasurer*), Prof. Dr. J. C. Ghosh (*Foreign Secretary*) and Proof. S. P. Agharkar and Dr. C. S. Fox (*Secretaries*).

* * *

University of Mysore.—I. EXAMINATIONS: The list of candidates who were successful at the S.S.L.C. Supplementary Examination held in November 1939 and declared eligible for admission to University Courses was published.

II. LECTURES: The following lectures were delivered:—(*i*) *University Extension Lectures*—(1) Mr. C. K. Venkataramayya, M.A., LL.B., Kannada Translator to the Government of Mysore, on "Poet Kumaravyasa" *in Kannada* at Chitaldrug. (2) Mr. A. R. Wadia, B.A. (Cantab.), Bar-at-Law, Professor of Philosophy, Maharaja's College, Mysore, on "The Problems of Industrial Civilization" *in English*, at Robertsonpet. (3) Mr. K. Sundaresan, L.M.S., Assistant Surgeon, Minto Ophthalmic Hospital, Bangalore, on "The Causes of Blindness", *in Kannada* at Davangere, and on "The Prevention of Blindness", at Chitaldrug. (4) Sri. B. Indiramma, M.A., Dip. Edn. (Leeds), Superintendent, Maharani's Women's Training College, Mysore, on "The need for a Knowledge of Child Psychology on the part of Parents", *in Kannada*, at Chickballapur and Chickmagalur. (5) Dr. A. Appadhorai, M.A., Ph.D., Loyola College, Madras, on "The Revision of Democracy", *in English*, at Mysore. (6) Dr. Kavoor T. Behnan, B.A., B.D., Ph.D., Department of Psychology, Yale University, on "Yoga—A Way of Life", *in English*, at Mysore, and on "Scientific Analysis of Social Phenomena", *in English*, at Bangalore. (*ii*) *Special Lectures*—Dr. M. V. Gopalaswami, B.A., B.Sc., Ph.D., Professor of Psychology and Logic, Maharaja's College, Mysore, on "The Nature-Nurture Problem in relation to Intelligence", *in English*, at Mysore.

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Announcements

Indian Science Congress, 1941.—The Twenty-eighth Session of the Indian Science Congress will be held at Benares from 2nd to 8th January 1941.

Sir Ardeshir Dalal, Managing Director of Messrs. Tata Iron & Steel Co., Ltd., has been elected General President of the Congress. The following have been elected Sectional Presidents:—Prof. K. Ananda Rao (*Mathematics and Statistics*), Prof. P. N. Ghosh (*Physics*), Dr. Mataprasad (*Chemistry*), Dr. M. R. Sahni (*Geology*), Dr. S. M. Tahir Rizvi (*Geography and Geodesy*), Dr. Sri Ranjan (*Botany*), Dr. A. Subba Rao (*Zoology*), Rao Sahib Y. Ramachandra Rao (*Entomology*), Mr. T. C. Das (*Anthropology*), Mr. A. C. Ukil (*Medical and Veterinary Research*), Mr. K. Ramiah (*Agriculture*), Dr. B. B. Dikshit (*Physiology*), Dr. I. Latiff (*Phychology and Educational Science*) and Sir M. Visvesvaraya (*Engineering*).

The Editorial Committee of the **Imperial Council of Agricultural Research** announce that, with effect from January 1940, a new monthly magazine entitled "*Indian Farming*" will be issued in place of the bi-monthly "*Agriculture and Livestock in India*".

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We acknowledge with thanks receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 50, Pt. 12.

"Agriculture and Live-Stock in India," Vol. 9, Pt. 6.

"The Philippine Agriculturist," Vol. 28, No. 7.

"Monthly Bulletin of Agricultural Science & Practice," Vol. 30, No. 10.

"Biochemical Journal," Vol. 33, No. 10.

"Journal of the Institute of Brewing," Vol. 45, Nos. 7 and 11.

"Journal of the Indian Botanical Society," Vol. 18, No. 3.

"Biological Reviews," Vol. 14, No. 4.

"Journal of the Indian Chemical Society," Vol. 16, No. 10.

"Journal de Chimie Physique," Vol. 36, Nos. 7–9.

"Comptes Rendus (Doklady)," Vol. 24, Nos. 6–8.

"Experiment Station Record," Vol. 81, No. 5.

"Indian Forester," Vol. 66, No. 1.

"Review of Applied Mycology," Vol. 18, No. 11.

"Calcutta Medical Journal," Vol. 36, Nos. 5–6.

"Bulletin of the American Meteorological Society," Vol. 20, Nos. 8–9.

"Scripta Mathematica," Vol. 6, No. 2.

"Indian Medical Gazette," Vol. 74, No. 12.

"Indian Journal of Medical Research," Vol. 27, No. 2 (October 1939).

"Nature," Vol. 144, Nos. 3654–57.

"Journal of Nutrition," Vol. 18, Nos. 2–5.

"Journal of the Bombay Natural History Society," Vol. 41, No. 2.

"Proceedings of the Royal Society of Edinburgh," Vol. 59, Part 2.

"Canadian Journal of Research," Vol. 17, No. 11.

"Journal of the Royal Society of Arts," Vol. 87, Nos. 4539–40.

"Indian Trade Journal," Vol. 135, Nos. 1747–49, and Vol. 136, No. 1750.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

December 1939. SECTION A.—B. SANJIVA RAO: *Studies in the Chemical Behaviour of Sulphur Compounds. Part I. The Hydrolysis of Sulphur Chloride.* The hydrolysis has been carried out at the interface between very dilute solutions of S_2Cl_2 in CCl_4 and aqeous alkali in the presence of cadmium hydroxide. The products are free sulphur, sulphide, sulphite and thiosulphite. The results can most satisfactorily be explained on the basis that disulphur oxide is the primary product of hydrolysis. B. D. SAKSENA: *Raman and Infra-red Spectra of Cyclopropane.* Assuming that cyclopropane molecule has a structure in which the carbons form a regular triangle and the hydrogens lie at tetrahedral corners out of the plane of carbon ring (symmetry group D_{3h}) the normal modes of vibration and the force constants have been calculated. The results are in good agreement with observations. S. S. BHATNAGAR, P. L. KAPUR AND G. KAUR (MISS): *Photopolymerisation of Anthracene in Benzene Solution from the Magnetic Standpoint.* The value of λ, the constitution corection factor for the bridged four-membered ring, has been determined by a magnetic study of the products of this photo-polymerisation. N. ANANTHANARAYANAN: *Diffraction of Light by a thin Metallic Half-plane.* The Fresnol diffraction patterns obtained with thin uniform metallic films having edges of razor-like sharpness, are characterized by a large number of fringes with high visibility on the darker side of the pattern. The changes in these patterns with increasing thickness of the film and also with wave-length of incident light are described and theoretically accounted for. B. SANJIVA RAO: *Studies in the Chemical Behaviour of Sulphur Compounds. Part II. Disulphur Oxide.* When the products of combustion of sulphur in oxygen under highly reduced pressure are passed into cold carbon tetrachloride, disulphur oxide S_2O is produced. This exists in the form of a stable complex with S_8.

December 1939. SECTION B.—G. VENKATARAMAN: *A systematic account of some South Indian Diatoms.* The diatoms described comprise the collections made by several workers —Prof. M. O. P. Iyengar, Dr. T. Ekambaram, Prof. R. Gopala Iyer, Dr. B. Sundararaj and the author. 98 Forms representing 33 genera are described. Of these, 67 are new records for India, 3 are new species, 6 new varieties and 6 new forms. HAMID KHAN: *Study in Diseases of Fish: Fin-Rot—A Bacterial Disease of Fins of Fish.* A rod-shaped bacterium present in large number in the infected tissues, has been incriminated as the causative agent for the fin-rot disease. Copper sulphate solution (1-20,000) bath for 10–15 minutes, has been found to cure the fry in early stages of the disease. It has not been found possible to cure the fish in advanced stages of the disease.

Indian Chemical Society:

October 1939.—JATINDRA CHANDRA PAL AND B. C. GUHA: *Combined ascorbic acid in plant foodstuffs—Part I.* PRATUL NATH SENGUPTA AND B. C. GUHA: *Combined ascorbic acid in plant foodstuffs—Part II.* BAIDYANATH GHOSH AND B. C. GUHA: *Concentration of ascorbigen from cabbage.* K. C. SAHA: *Distribution of free and total ascorbic acid in the liver and muscle of Bengal fresh-water fish.* PHULDEO SAHAY VARMA, K. S. VENKAT RAMAN AND (MISS) K. M. YASHODA: *Condensation of asrenic chloride with dialkyl aromatic amines.* SHARIFUDDIN WARSI AND SALIMUZZAMAN SIDDIQUI: *The constituents of* Didymocarpus pedicellata. *Part IV. Isolation of two new colouring matters and their relationship to pedicin.* MUHAMMAD QUDRAT-I-KHUDA AND AMALENDU KUMAR RAY: *Chemistry of spiro-compounds. Part I. Preparation of cyclo-pentane spiro-cyclopentanone and* cyclo*Hexane-spiro-cyclo-heptanone.* MUHAMMAD QUDRAT-I-KHUDA AND ASUTOSH MUKHERJEE: *Chemistry of spiro-compounds. Part II. Synthesis of cyclo-pentane-spiro-cyclopentanone.* M. S. TELANG AND V. V. NADKARNY: *Kinetics of the reaction between potassium persulphate and the alkyl iodides. Part I. Influence of solvents, acids and salts.* K. P. BASU AND K. GUPTA: *Biological value of the proteins of some species of Bengal fish by the nitrogen balance and growth methods.* PRATUL NATH SEN-GUPTA AND B. C. GUHA: *The estimation of Vitamin C in foodstuffs.* M. P. SHAH AND V. B. THOSAR: *A note on the action on nitrosyl chloride on monobromomalonamides.*

South Indian Science Association, Bangalore:

August 30, 1939.—K. S. GURURAJA DOSS: *A New method of determining the cross-section of molecules.*

November 21, 1939.—SIR C. V. RAMAN: *Prof. Lawrence and the Cyclotron.*

December 14, 1939.—N. V. RAGHUNATH: *Ceramic Industry in India.*

Indian Botanical Society:

November 1939.—EDWARD BARNES: *The species of Geraniaceæ occurring on the Travancore High Range including the description of a new Balsam.* B. N. SINGH, S. SAMPATH AND R. K. BANSAL: *A new fixative for plant smears.* P. N. GHATAK AND T. C. ROY: *Studies in the soil fungi of the paddy-fields of Bengal. I. Fungi of an unmatured paddy-field of the Chinsura Agricultural Farm.* D. CHATTERJEE: *Some dominant plants of India.*

SUPPLEMENT TO CURRENT SCIENCE

Vol. IX] INDIAN SCIENCE CONGRESS, MADRAS, 1940 [No. 1

PRESIDENTIAL ADDRESS

Congress President:

PROFESSOR B. SAHNI, M.A., Sc.D., D.Sc., F.N.I., F.R.S.

THE DECCAN TRAPS: AN EPISODE OF THE TERTIARY ERA

The Eocene Age: A 'Dawn of the New'

LESS than six months ago the **British Association for the Advancement of Science** met under the presidentship of a renowned scientist. In his address at Dundee, Sir Albert Seward gave a vivid account of the way in which, by a study of fragments, such as samples of rocks and of the remains of plants preserved in them as fossils, he was able to visualize a scene in the west of Scotland at the dawn of the Tertiary era. As a pupil I feel tempted to follow his example, and to attempt a reconstruction of an Indian scene at about the same period of the earth's history.

But I would ask you to bear with me if I seem at times to be telling a fairy tale. For at this distance of time we can only see a dim outline of the world as it was, and the exact language of science is ill-suited to the description of visions.

Competent authorities place the dawn of the Tertiary era between sixty and seventy million years ago. It is the birth of a new era in a very real sense. Stupendous forces, surging in the womb of the earth, had already caused gigantic rifts in the crust, and these rifts are gaping out into oceans. From smaller fissures in the crust, molten rock is now pouring forth in repeated floods of lava which will cover millions of square miles of land and sea. Vast areas are being converted into desert by showers of volcanic ash. A new type of landscape develops, with high volcanic plateaus as a dominant feature. The face of the earth is rapidly changing. She puts on a more modern garb of vegetation; the land, lakes and rivers become peopled by creatures more familiar to us. Still there is no sign of man. But the stage is being set for his arrival. For this critical period foreshadows the birth, out of the sea, of the mightiest mountains of the world; and the heaving bosom of the earth, somewhere to the north of India, is to be the cradle of man.

Such was the Eocene age: it was literally a 'dawn of the new'.

Early History of the Deccan

To arrive at our early Tertiary scene in India we can either work backwards from the present, or approach it from a still earlier past and try to appreciate the setting in which that scene was laid. I prefer the latter course, although for a few moments it will take us far behind the period with which we are specially concerned. For we shall have to go back to a time, at least three hundred million years ago, when neither the Atlantic nor the Indian Oceans were yet born.

Opinion is by no means agreed even upon the broad distribution of land and sea prior to the Tertiary era. But according to a theory now generally associated with the name of Professor Wegener, who died a hero's death in Greenland a few years ago in the pursuit of Science, all the land areas of the globe were once directly united together into one world continent. The two Americas lay much further to the east, while Europe and Africa lay further west, than at present. Greenland, Iceland and the British Isles were all much closer together and were wedged in between Canada and Scandinavia. South America fitted into the great angle in the west coast of the African continent. Australia and Antarctica lay close up against the south-eastern coast of Africa, with the southern tip of India in contact with Madagascar and wedged in between the African and Australian blocks. At this remote period the South Pole was somewhere in Cape Colony.

At intervals during a period of several hundred millions of years disruptive forces of unthinkable magnitude have caused ever-widening fissures in the crust. The Great

Rift Valley of Africa is believed to be one of the youngest of these fissures, still in the making. The Red Sea rift has now become two hundred miles wide; the Atlantic rift is already an ocean. And thus, like icebergs breaking off by the formation of crevasses from the snout of a glacier, or from the edge of an ice-sheet that has spread out to sea, the continental blocks are supposed to have drifted away into their present positions. But these continental movements have not been all movements of separation. They have also brought into contact with each other land blocks formerly sundered by the ocean.

Here, in Madras, we stand at the eastern edge of one of these blocks which, according to Wegener, has drifted—and perhaps is still drifting—north-eastwards from its former position in the southern hemisphere. To the north of it formerly lay the great Tethys Sea which once separated it from the main Asiatic mass. The Asiatic block, in turn, has moved south-west, towards India. As the two great land masses approached each other, narrowing down the width of the intervening sea, parts of the ocean floor were caught up as between the jaws of a gigantic vice, and they have been squeezed, crumpled and uplifted into the chain of the Himalayas.

A Primeval Landscape

By far the greater part of the Indian peninsula is made up of rocks that have solidified from a molten state. But the igneous activity which these rocks indicate took place in distinct periods separated from each other by a span of time of which no adequate estimate is yet possible.

The eastern and southern portion of the peninsula (shown red in geological maps) forms one of the most ancient land surfaces of the globe. Parts of it are believed to belong to the primeval crust of our planet as it first cooled and condensed from a gaseous or liquid mass.

From time to time other molten rocks from the interior have burst through this crust and solidified in the cracks, forming thick sheets or walls cutting across the older rocks. The early convulsions of the earth while she was young are still recorded in the complex folds into which these archaic rocks have been thrown. Over large areas the original rocks have been fractured by earth movements or so badly crushed and altered that we can no longer tell their mode of origin.

This was the kind of primitive landscape on which, long afterwards, life first originated (in water) and on which the stratified crust of the earth was laid down. With the passage of time the greater part of this crust has worn away, and the old surface has again been laid bare. But portions of the strata still remain, protected in deep trough-like hollows in the old river basins, the Mahanadi, the Godavari and the Narbada, and in a string of outlying patches along the east coast, from Trichinopoly as far as Cuttack. These deposits were laid down chiefly in lakes and rivers, but partly also in shallow seas that flooded the land from the north and east. The wealth of evidence these strata contain tells of great changes of climate and of a long succession of floras and faunas that lived on the vast southern continent of which India once formed an integral part.

Except for these temporary incursions of the sea the plateau of the Deccan has remained a land area, so far as we know, ever since the original crust was formed.

We have seen that the eastern and southern parts of the peninsula are composed mostly of rocks of great antiquity. Similar rocks, in fact, form the foundations of all the continental blocks, the eroded tops of the ancient mountains often projecting through rocks of more recent date. The Nilgiris, and the Palni and Annamalai Hills, are composed of large dome-like masses of semi-molten rock which have heaved up the overlying crust and have later been exposed by the denuding action of rain and rivers. These primeval hills usually have rounded, undulating outlines. Occasionally an isolated dome rises suddenly out of the alluvial plain. There it stands, like a petrified sentinel of the hoary past, with his face obliterated and his feet buried in the dust of ages.

Through untold æons of Time Nature has carved this ancient surface into fantastic shapes. Great masses of rock sometimes lie uneasily perched one on top of another in threatening piles, like dilapidated towers. Vast areas are strewn with enormous weathered blocks lying in utter confusion, as if a great city, where only giants must have lived, had been laid in ruins. Occasionally a huge sphere of granite lies precariously poised on the rounded back of a hill as if one could, with a mere push, send it hurtling down the hill-side. A later day has seen the handiwork of man superimposed upon Nature's in sculptured epics like those at Mahabalipuram—unsurpassed in the

grandeur of their conception or in the depth of devotion that inspired them.

THE DECCAN TRAP COUNTRY

Very different is the landscape in the central and western parts of the Deccan, coloured green, by convention, in all geological maps. This is much younger ground, for as we step over from the red part of the map to the green we traverse, at a single bound, a vast span of geological time: in most places the newer rocks rest directly upon the eroded surface of the old foundations. Abruptly we are transported into a new era of the earth's history. In fact we have arrived at the dawn of the Tertiary. After a long period of quiescence the volcanic energy pent up in the interior of the earth is now bursting forth in floods of lava on a scale never witnessed before or since.

Delegates to this Congress who have travelled here from the north by way of Bombay or Nagpur must have noticed the long, low, flat-topped hills which dominate the scenery over the greater part of the country drained by the Narbada and Tapti and by the upper reaches of the Godavari and Krishna rivers. The same type of scenery extends into Kathiawar and Cutch, and for at least two hundred miles north of the Narbada. Crossing the Western Ghats from Bombay to Poona the railway climbs up through gorges cut through a series of terraces at different levels, like the remnants of a gigantic staircase. These terraces are the exposed surfaces of successive sheets of lava which were poured out at intervals, during a period that must have extended through many thousands of years, and which on the west coast were piled up to a thickness of 6–10 thousand feet.

THE DECCAN BEFORE THE ERUPTIVE PERIOD

With the fragmentary data at hand let us try to picture the geography of the Deccan during the Cretaceous epoch which preceded this era of fire and devastation. The south-east coast is flooded by a shallow sea, teaming with life, from Trichinopoly as far as Pondicherry. The same sea stretches north-eastwards into what is now the Province of Assam, for similar types of fossil shells have been found in the two regions. Near Utatur we may pick up fossil timber, riddled with holes made by extinct types of wood-boring molluscs. The shells of the creatures still lie in their burrows, petrified within the wood: the logs must have drifted down an east-flowing river into an estuary or lagoon a hundred and fifty miles south of Madras.

The northern sea has also overflowed the land, in the region of the lower Narbada. But the fauna here is very different, because the barrier of the plateau cuts it off from the southern sea. The northern fauna is more allied to the European—in fact the same ocean stretches on one side into Europe and on the other as far as Tibet and China.

But of our western coast at this period there is no evidence; either India has not yet split away from Africa; or, what seems more likely, it has brought away with it a large tract of land which lies to the west. By the sinking of this tract the gulf between India and Africa will widen out into the Arabian Sea, isolating our triangular island of the Deccan which, like a gigantic raft that has been cut adrift, will continue on its long journey to the north-east.

Amongst the denizens of the land, dinosaurs abound in the forests of the Central Provinces. Many of them belong to types peculiar to India but, strangely enough, they have their nearest relatives among the dinosaurs of Madagascar and South America: there must still be some land connexion left that allowed these reptiles to intermigrate. But they are rapidly running out their race. The last of the Indian dinosaurs lie buried in the Lameta beds near Jabalpur and at the village of Pisdura near Warora, to the south-east of Wardha.

THE DAWN OF THE TERTIARY ERA

We are now approaching the end of the Mesozoic era. The old southern continent is breaking up. The gulfs widen. The same sea that washes the northern shores of the Deccan receives the rivers that drain parts of Egypt, France, Belgium and England. It also laps the shores of Mexico in the far west. In the far east, it sweeps southwards, past Borneo. This is the equatorial ocean of the time, the birth-place of the great mountain ranges of the world in the era that is to come.

It is over such a scene as this that the Tertiary era dawns, with the lurid light of volcanic outbursts. There are, indeed, no volcanoes in the familiar, Vesuvian, sense. The lava wells up quietly through fissures in the earth. But these fissures are hundreds of yards wide and stretch for miles across the country, with crooked cracks branching off to right and left, all brimming with the fiery liquid. In the Rajpipla hills near Broach, in Cutch, Kathiawar and other parts of Western India, some of these old fissures

can still be recognized, with the lava solidified inside them in the form of walls or dykes.

The Deccan lavas, being rich in iron, are of a specially fluid kind that takes long to set. They flow almost like water, filling up hollows in the land and spreading rapidly in horizontal sheets, covering miles of country before they harden into the basalt or 'trap' rock that is familiar to us. In its devastating march the 'fiery deluge' bakes up the soil and consumes all surface vegetation. The very earth is on fire.

Pools and tarns begin to seethe as the lava flows over them. Here and there a stream is dammed up and collects its waters in a temporary lake till it finds or makes a new channel, or the lake itself is covered up by another eruption. The bigger rivers, not so easily blocked, manage to keep their old course, gradually cutting their way through any lava flows that might cross their path. But the eruptions continue from time to time, and from place to place over an enormous area, originally perhaps half a million square miles, from Rajahmundry to Cutch and from near Dharwar almost as far as Jhansi; piling sheet upon sheet of molten rock and loading the old foundations under a plateau thousands of feet thick. Even after the continuous erosion of millions of years the Deccan traps still cover an area of 200,000 square miles, and you can travel all the way from Nagpur to Bombay, a distance of five hundred miles, without ever stepping off the volcanic rocks. Their abrupt ending along the west coast, where they are thickest and form the great scarp of the Western Ghats, leaves us no real measure of their original extension into the tract of land that foundered into the Arabian Sea.

It is difficult to tell where, in the enormous area of the Deccan traps, this igneous activity first began. The traps of the Nagpur-Chhindwara region were certainly among the earliest to be poured out and, so far as we know at present, the highest flow of the series is to be seen on Malabar Hill and at Worli in Bombay. It appears the vulcanicity began in the eastern parts of the Deccan and gradually spread to the west.

The lava flows vary in thickness from a few feet to as much as a hundred. As one flow overlaps another, it seals up the old fissures, and any later eruptions have to force their way up through the entire pile. There is a tremendous outburst. A fresh crack has been rent open, or an old one has split wider. The yawning mouth of Hell roars with thunder, and hurls fire and smoke and ashes miles up into the sky, as if spitting curses on Heaven itself.

The ash comes down again, raining upon the lava still hot round the fissures, perhaps raising a mound here and there; or it extends the desolate waste by burying under its weight any fresh vegetation farther afield. Beds of volcanic ash abound in many parts of western India, specially round Poona and Mahabaleshwar. There must be an eruptive centre in the vicinity.

If a lake or river happens to be near by, the ash settles down on the water, forming a sort of volcanic sediment in which the creatures living there find a speedy grave.

But it is an immortal grave. For, through a process that is still largely a mystery to us, the bodies of these plants and animals become imperishably preserved. Particle for particle, cell for cell, the plant tissues are replaced by silica derived from the ash, or from a lava flow that may have overwhelmed the lake; and in the end we are left with an exact replica of the original in hard, indestructible silica.

This is not a mere cast or an impression of the external features of the plant, but a petrifaction in the strict sense, which you may cut into thin sections and of which you may examine under the microscope the minutest details of the anatomy. The preservation of the tissues is sometimes so perfect, and the resemblance with the tissues of modern plants is so complete, that while engrossed in their investigation in the laboratory we are apt to forget that we are dealing with forms of plant life that existed fifty or sixty million years ago.

Partly with the heat of the lava, but largely through the action of percolating minerals, the entire bed of the lake becomes hardened into a rock that rings under the hammer like a piece of steel. Embedded in the mud and silt are also the remains of any land plants, or the bones of animals living on the banks, that may have been carried down by a stream. Thus we may have a whole flora and fauna sealed up in a bed of volcanic ash, or in lake and river deposits interbedded between sheets of lava.

Life in the Deccan Trap Period

After what I have said it will be easy for you to picture the conditions in the Deccan trap period, and to realize how valuable for the historian of plant and animal life must be the documents preserved

in these intertrappean beds. They have their value, too, in the study of rocks, for the state of evolution of a flora or a fauna gives a measure of geological age more trustworthy than any yet discovered.

The age of the Deccan traps has now been a matter of discussion among geologists for over seventy years. The main point at issue was whether the volcanic period began during the decline of the Mesozoic era or at the dawn of the Tertiary. To most of you, the wranglings of geologists over the age of a stratum may seem rather futile and meaningless. But apart from its scientific interest, a precise knowledge of the positions of strata in the geological time scale is of value in the exploitation of the mineral wealth of the earth.

We shall revert a little later to the question of the age of the Deccan lavas, for on this question the flora of the intertrappean beds gives evidence which, I venture to believe, is decisive. First let us examine a few selected specimens from this remarkable museum of plant antiquities.

By far the greater part of our knowledge of this flora is based upon collections made in the Nagpur and Chhindwara districts. This is a fortunate fact because here, as we have seen, some of the lowest beds of the series are exposed. According to Sir L. Leigh Fermor these are the oldest beds in the whole series, so that if we could fix the age of the fossils preserved in them we should know when the volcanic activity began. From here we have a great variety of spores, seeds and fruits; abundant remains of water-ferns and other aquatic weeds; different species of the lowly fungus order, sometimes found within the tissues of other plants which they have reduced to decay, as well as numerous kinds of petrified timbers, including palm stems in bewildering variety and number. Associated with these plant remains are the relics of animals that lived at the same time: the shells of many types of freshwater snails, the scales and bones of different kinds of fish, the wings of insects, and the skeletons of many other creatures of land and water. All these relics lie buried in a common grave.

Some of the earliest plant collections were made about ninety to a hundred years ago, chiefly by Christian missionaries, medical men and military officers in the service of the East India Company. Among these men the name of Stephen Hislop will always stand out prominently. It is a pity that this valuable material was not described in Hislop's day, for some of his most interesting specimens, mentioned in his published letters, can no longer be traced. I owe to the kindness of Mr. W. N. Edwards of the British Museum the loan of what remains in London of the Hislop collection. The rapid sketch I am about to attempt is based partly on this material, but mostly on specimens collected in recent years by members of the Geological Survey of India, by Professor K. P. Rode, S. P. Agharkar and P. Parija, by Mr. V. N. Shukla and myself. In the investigation of this material several workers have taken part and it is a pleasure to acknowledge the assistance I have received from the late Professor B. P. Srivastava, Mr. H. S. Rao and Mr. K. N. Kaul.

The intertrappean plants of the important area near Rajahmundry, which must have lived in the brackish waters of an estuary, are being investigated by Professor L. Rama Rao and his associates at Bangalore. These Rajahmundry beds are also low down in the series, and the plants probably lived at about the same time as those of Nagpur-Chhindwara.

Among the commonest fossils in the Deccan beds are some extinct species of stoneworts known under the expressive name *Gyrogonites,* derived from their tiny spirally twisted fruits. The great majority of species of this genus, described from France, England and other countries, are of early Tertiary age, and it is interesting that some of these are identical with our Deccan forms.

Some microscopic branched filaments, no doubt belonging to fungi, are seen attached to reproductive organs of two different kinds. One form, with more or less spherical closed bodies of a dark colour, recalling the fruit bodies of modern mildews of the family Perisporiaceae, has been described as a new species, *Perisporiacites varians.* The other has flask-shaped bodies. and for this the genus *Palæosordaria* has been created. Very little is known of the fossil history of the Perisporiaceæ and Sordariaceæ, but the few previous records, whatever their worth, are all from rocks of Tertiary age. The Deccan fungi were discovered in certain lake-muds at Sausar, midway between Nagpur and Chhindwara.

In the same lake deposits were found, in great abundance, the remains of *Azolla,* a familiar genus of small floating water-ferns which even to-day cover stagnant pools in many parts of the world. The

extinct species from Sausar, which has been named *A. intertrappea,* is geologically the oldest known form of the genus: a striking example of the tenacity with which even highly specialized forms of life can persist through the ages. The preservation is so perfect that most of the details of the anatomy, specially of the reproductive bodies which are highly characteristic of the genus, have been studied. Some hollow spherical bodies, associated with the *Azolla,* no doubt belong to an unknown genus of water-ferns, probably related to the modern *Salvinia:* the provisional name *Massulites* has been given to them. The spongy mass of which the body is composed contains small spores embedded in it much in the same manner as in *Salvinia.* Among many types of free-lying spores seen in the same rocks are two which deserve special mention. They are of two very different sizes, but they resemble each other so much in certain peculiar features that they appear to be the megaspores and microspores of one and the same species, most probably another water-fern. The interesting point about them is the close resemblance they show, both in their structure and in their mode of germination, to the two kinds of spores, large and small, of the rare genus *Regnellidium,* which to-day is confined to South America. So far as I know, the water-ferns are unknown from rocks older than the Tertiaries.

In the Hislop collection at the British Museum there are a number of seed-bearing cones; some of them were found embedded in volcanic ash. The new name *Takliostrobus* has been given to one of them after Takli, a suburb of Nagpur, where it was discovered. Another has been named *Indostrobus*; a third was referred to the old genus *Pityostrobus.* All these cones have peculiar features of their own but the fact that in all of them the scales bear a pair of elongated seeds on the upper surface indicates that they were distantly related to our modern pines and deodars.

Of the several kinds of seeds found at Sausar, there is one intriguing type, *Sausarospermum,* remarkable for its several antique features. It recalls the seeds of certain fern-like plants from the coal measures of Europe, but it is hardly conceivable that there is any real affinity between them; at present it is best to reserve opinion on this matter. The name *Viracarpon* has been given to a cylindrical fruit, derived from a number of small flowers densely crowded on a thick axis. This is from the Hislop collection and it may be the very specimen which he mentions in his writings as a mulberry-like fruit, though unfortunately he never described it. The resemblance to a mulberry is purely superficial, for each flower produced a group of six seeds. It is impossible to say anything yet about the affinities, except that the nearest resemblance that I have so far been able to trace is with the fruits of certain palm-like plants of the family Cyclanthaceæ, now confined to tropical America.

A very interesting fruit, *Enigmocarpon,* was first discovered by Professor Rode near his home at Mohgaon Kalan, east of Chhindwara. The name is eloquent of our ignorance concerning its affinities, but the structure is perfectly preserved. It is an elliptical 8-chambered fruit about the size of a large pistachionut, with numerous dicotyledonous seeds in each chamber, attached on a central column from which the eight partitions radiate. The wall of the fruit is thick and spongy: the fruit was no doubt dispersed by water. To let out the ripe seeds the fruit wall bursts lengthwise, neatly, down the middle of each chamber.

Among Hislop's specimens are two species of cardamoms, both very like the small green kind that we commonly offer, with other spices, to guests in our homes. One of the specimens was so deceptive that a friend actually tried to peel it, till he discovered that it was petrified. In one broken specimen the seeds are exposed, showing their characteristic wrinkled surface.

The other monocotyledonous fruits all belong to palms: some have been described under the general name *Palmocarpon* which may include fruits belonging to widely different kinds of palms. One was named *Tricoccites* because of its supposed resemblance (which has proved deceptive) with the fruits of the Euphorbia family. It has three large chambers, each occupied by an equally large oblong seed. The fibrous fruit wall is thick and adapted for dispersal by water. It seems to have been divided up into a number of longitudinal chambers separated by partitions of hard tissue. The 'chambers' may have been quite empty, or filled with a loose spongy tissue which acted as a float. The surface was covered by a thin, smooth, water-tight rind. The whole fruit was about the size of a walnut, which it superficially resembled also in having a curious beak-like point.

But the most interesting of the Deccan palm fruits is one which Hislop writes he had found, but of which we have not been able to trace the original specimen. It is the fossil genus *Nipadites*, so called because of its resemblance with the fruit of the modern stemless palm *Nipa fruticans*, which forms dense clumps to-day in many tropical estuaries, and is common in the Sundarbans. Eighty years after Hislop's discovery was announced Professor Rode found another specimen at Mohgaon Kalan. This specimen shows all the characters of the modern genus, so we need have no hesitation in calling it a *Nipa*, although the species is different. The fruits of *Nipa* are by far the commonest fossils in the London Clay, which everybody agrees was deposited in the Eocene period; they have also been found in the Eocene of Belgium, and of the Paris basin, in fact, in the very grounds of the old Trocadero, now dismantled; also in the Mississippi basin, in southern Russia, in Egypt and in far-off Borneo. These fossil records of a brackish-water plant help us to draw at least roughly the coastline of the old Tethys sea, which must have swept the northern shores of the Deccan not far from where Chhindwara now stands. This important genus is scarcely known from rocks older than the Eocene.

It is interesting to see this evidence of brackish-water conditions in the Deccan supported by the fossil remains of aquatic animals. Dr. Hora describes several kinds of fossil scales belonging to types of fish which ordinarily inhabit fresh waters near the sea-shore but are capable of descending to the mouths of rivers. It is interesting, too, that on the whole the evidence of the fish-remains from the Deccan beds, first emphasized by Sir Arthur Smith Woodward over thirty years ago, and now confirmed by Dr. Hora, is in favour of an Eocene age; and Professor Bonnema wrote to me that the same is the case with the remains of some small crustaceans which show a treacherous resemblance to the seeds of plants.

But we must return to the palms, for these are by far the most important constituents of the intertrappean flora, and no doubt must have dominated the vegetation of those days. As a rule we only find bits of petrified stems which, for lack of a proper system of classification, we lump together under the artificial genus *Palmoxylon*; although among them there must certainly be many distinct genera that we could easily recognize, if we only knew the flowers or fruits. Sometimes we come across entire trunks, or large portions of them, with the thick mantle of roots still attached round the base. At the Nagpur museum there is a fine specimen, probably discovered at Saugor in Central India well over a hundred years ago; and in 1934 I was able to unearth from the dust and oblivion of the vaults of a Bombay museum a heap of petrified palm stems, some of which were certainly collected at Saugor before the year 1857. It is this very collection that H. J. Carter mentions in a paper of that date, but which had apparently been lost. Luckily, silicified plants do not deteriorate with age: they are immortal, as I have explained already; but alas, most of the labels are gone, except those that were painted on the specimens.

By their sheer number and amazing variety these palms of the volcanic period compel the attention of geologists, because from all accounts it appears that this family of plants, although it first arose in the Cretaceous period, did not rise to any prominence till after the Mesozoic era had begun.

The Age of the Deccan Lavas

I have tried to put before you, as briefly as I can, what we know to-day of the fossil flora of the north-eastern part of the Deccan. For deciding the question of the age of the Deccan traps it is perhaps unfortunate that so many of the plants are new to science and confined to this country; but, of course, they have an interest of their own. For the rest, you will have noticed that from what we know of the geological history of the stoneworts, the fungi, the water-ferns and particularly of the palms, which formed such a vast proportion of the flora, everything seems to point to a Tertiary age. What is more, the fishes and the crustaceans, too, seem to fall into line with the plants.

So much for the Nagpur-Chhindwara traps which, according to the geologists of the Indian Survey, are the oldest in the whole series. For all we know, the Chhindwara traps may have flowed out into an arm of the northern sea which was not far off. The lavas of the east coast, too, seem to be equally old. Professor Rama Rao and his colleagues, Messrs. Narayan Rao and Sripada Rao, have quite recently found stoneworts and other algæ of early Tertiary age in the estuarine beds of Rajahmundry, at the head of the Godavari delta.

It is curious that no intertrappean beds

at all have been discovered in the middle part of the series, which we cross as we travel towards the west coast. Not until we actually reach Bombay Island, where the highest members of the series are exposed, do we again come upon any sedimentary beds. It may be that during the middle part of the volcanic period the lavas were poured out in such rapid succession that no time was allowed for any plants or animals to colonize the desolate surface. Still, I think, a search ought to be made for traces of fossils along the planes between the lava flows, *e.g.*, at Matheran, Poona and elsewhere.

In the highest intertrappean beds, namely, those at Malabar Hill and Worli, plenty of organic remains have been collected, including a multitude of skeletons of a pigmy species of frogs. I have not seen any plants from here and cannot say whether these beds are much younger (geologically speaking) than those of the Central Provinces. But this seems to me unlikely, because we are told that near Surat and Broach the highest traps there are covered by marine beds of definitely known Eocene age. If this is true, then here, at least, the volcanic activity must have already come to a stop before the sea began to encroach upon the land in early Tertiary times. According to Professor V. S. Dubey the radio-active content of some of the traps in western India also indicates an early Tertiary age.

Thus the chances are that the whole of this imposing thickness of thousands of feet of igneous rock was poured out within the relatively short interval of the Eocene period. Quite probably this terrible drama of fire and thunder was only a brief episode of the very earliest part of the Eocene. The thickness of a stratum is by itself no measure of time. For after all it would not take long for a lava flow a hundred feet thick to be poured out like a flood from a fissure volcano, once it came to business. It is the deposition of the relatively thin sedimentary beds during the quiet intervals that must have taken up most of the time of the Deccan trap period.

The conclusion that the Deccan traps were poured out at the dawn of the Tertiary era and not at the close of the Mesozoic, brings them into line with other vast outpourings of Eocene lavas: for example, those that now cover at least 200,000 square miles of the north-western United States and the equally wide-spread lavas of the old Thulean continent that once united the western Isles of Scotland with Iceland, Greenland and other arctic lands.

Before I close I ought to say that this idea of the Tertiary age of the Deccan traps is by no means a new one. Indeed, it is over a hundred years old, for it was first put forward, so far as I know, by Malcolmson in 1837; and it was repeatedly expressed by Hislop and others in the middle of last century. In later years the question has been discussed and rediscussed by so many, and from so many different angles, that we could hardly see the wood for the trees. But the pioneers were right, as they so often are. They saw things more clearly because they worked with a clean slate and, as we all know, a clean slate is a very useful thing.

But the pioneer geologists were right also for another reason. They did not despise the mute but eloquent testimony of the plants that suffered the fiery ordeals of the dawn of the Tertiary era. For, as the first flashes from the fissure volcanoes flared up on the eastern horizon, the stalwart Palm said to the little *Azolla*:

This lurid light is not a sunset glow-
It is the herald of a morn.

And the fact is that this was the dawn of a new era: for, look at the number of Eocene genera of plants and animals that survive to this day.

Conclusion

We have now seen the contrast between the red part of the map and the green. Between the two lies a vista of time stretching back through well-nigh two thousand millions of years. But man, a recent creature of the earth, has united them in one poem of duty to his Creator: if the foundation rocks of the south have given us Mahabalipuram and the Seven Pagodas, the Deccan traps have given us Ajanta and Ellora.[1]

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[1] In this popular presentation of the subject of the Deccan traps references to original sources have been purposely omitted. Those interested will find most of these works cited in an address delivered before the Botany Section of this Congress in January 1938, at the Jubilee Session held jointly with the British Association for the Advancement of Science (see *Proc. 25th Ind. Sci. Cong.*, 1938, Part II, pp. 33–76; reprinted as Lucknow University Studies No. II, pp. 1–100, 1938).

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A GREAT EDUCATIONAL INSTITUTION

DURING the first fortnight of this month the Madras Presidency College celebrated its Centenary with great social pomp and academic pageantry. The old students, who had assembled on this historic occasion to testify their affection and loyalty to their College, were legitimately in a holiday mood, and the present students, temporarily relieved of their anxious thoughts about books, studies and examinations, must have naturally made the most ardent contributions to the gaiety of the varied festivities, which, judged by the press reports, were ingeniously conceived and delightfully enjoyed.

This great Institution, during the long period of its existence, has been a fertile cradle in producing distinguished young men, who in later life have achieved remarkable success in the different spheres of public activities in which they were engaged. On this memorable occasion which, in certain respects, marks the turning-point in the career of the College, it must have been a matter of pride and pleasure to the staff and students to recall to their memory the names of those eminent men who are no longer with us, and who have left indelible impressions of their genius on whatever work it was their lot to perform. We need offer no apology if we respectfully recollect the names of Raja Sir T. Madhava Rao, C. Rangacharlu, R. Raghunatha Rao, Sir A. Seshayya Sastri, Sir K. Seshadri Aiyar, Dewan Bahadur S. Srinivasaraghava Aiyangar, Sir P. Rajagopalachariar, Sir T. Muthuswami Aiyar, Sir V. Bhashyam

Aiyangar, Sir C. Sankaran Nair, V. Krishnaswami Aiyar, V. Satagopacharlu, Sir C. V. Kumaraswami Sastriar, P. Ranganatha Mudaliar and S. Kasturiranga Aiyangar, whose outstanding achievements as statesmen, jurists, educationists and journalists form the noblest and the most enduring record of public service in this country. It would be almost impossible to compose a vivid picture of the personality and the human qualities of any of these eminent men from their works alone, however deeply they may bear the unmistakable marks of the artificer's intellect and character; and those who have seen their features and have heard their voice are few already, and become fewer yearly. It is, we believe, reasonable to assume that the Presidency College, which justly takes credit for having produced these great men, should not permit their memorials to become legendary, which, if carefully preserved in its Centenary Commemorative Volume, would constitute a perennial source of inspiration to the rising generation.

Though the task is certainly unenviable, yet we cannot resist the temptation of making a selection of some of the old graduates of the College, who are happily among us, and who deservedly are held in great public esteem. The names and accomplishments of C. Vijayaraghavachariar, Sir P. S. Sivaswamy Aiyar, Sir C. P. Ramaswami Aiyar, Sir V. T. Krishnamachariar, Sir T. Vijayaraghavachariar, Dewan Bahadur N. Gopalaswami Aiyangar, Sir C. Venkataraman, Sir K. Ramunni Menon, undoubtedly form the most stimulating and glittering chapters of our public annals. Both as the oldest politician and as a fearless and selfless advocate of his country's interests and aspirations, C. Vijayaraghavachariar is universally honoured. His services will be gratefully remembered, and, in these days of doubt and difficulty, his courage and patriotism will be an example to the succession of students who may adopt politics as their profession. By temperament and training, Sir P. S. Sivaswamy Aiyar is a scholar, erudite in law and letters, whose brilliance in culture is only equalled by his piety and philanthropic zeal, and whose eminent status in public life is as much based on his solid achievements in the fields of education, legislature and administration as on the supreme worth and value of his personal character. As a genius marked off from his gifted fellowmen, Sir Venkataraman is the Indian Eclipse in the realm of Science, whose amazingly brilliant contributions have earned for him the greatest international honours open to scientists. His fame is undoubtedly a national asset and will endure as long as the Physical Sciences are treasured by mankind. His character is not easily or concisely expressed in the form of a simple mathematical formula, for it is multilateral, whose principal facade is a consuming passion to do science. For sheer versatility of intellect and forceful personality, Sir C. P. Ramaswami Aiyar is practically unrivalled. His mind is so profoundly comprehensive that he could with equal authority discourse on the attributes of the Deity, the French Dramatists, Biochemistry and the American Constitution. To talk to him is liberal education. Sir V. T. Krishnamachariar, Sir T. Vijayaraghavachariar and Dewan Bahadur N. Gopalaswami Aiyangar are distinguished administrators, who have attained fame and greatness by their singular devotion to duty and by the

eminent qualities of their character. They are perfect models for the younger generation to emulate and mould their ideals upon. Sir K. Ramunni Menon's distinction rests upon his accomplishments as an educationist and administrator, and his meritorious services to his College and to the University will be cherished with feelings of love and gratitude. It would be difficult at the present moment to form a just estimate of the significance of his contributions to the development of higher University Education in South India.

As a group, the students of the Presidency College have been men of all-round ability, vigorous, alert and keenly interested in many things outside their professions, with an immense record of honourable work to their credit.

The Presidency College at one time enjoyed the reputation of being an aristocratic institution, receiving within its portals princes and patricians, which used to provoke the retort that it fell to the lot of other colleges to produce princes and patricians among their scholars. Whether it really possessed this dubious reputation or not, the staff relied, almost to the point of religious fervour, on the theory that impersonal teaching of prescribed text-books formed the backbone of sound Indianism, with the result that the students imbibed all their lessons and even the superiority complex of their professors. However, within the last three decades, a great change has overtaken the College which, having shed its aristocratic clothes, has assumed the humbler garments of democracy and even the graceful short-skirts of feminism. This alteration in the spirit and the complexion of the College has followed in the wake of the progressive Indianisation of its staff,—a body of eminent scholars and scientists, who worthily uphold the high formal academic standards for which it was always distinguished. It seems to us that the traditions of any educational institution are built up by the co-operative effort of the members of the staff and the students, and this body of traditions is enriched by the achievements of the latter when they enter life. From the standpoint of output of scientific investigations, none of the South Indian Colleges were distinguished till 1900 except, perhaps, in one department of study in the Presidency College, where the researches of Sir Alfred Bourne led to his election into the Royal Society. It is a sad reflection on the scientific teaching of our colleges, that after decades of toil and travail, we could produce a single Sir Venkataraman. The most baneful influence that pervaded the academic atmosphere of the higher educational institutions of South India in the last century was the competitive spirit, which manifested in the form of a rivalry for annexing prizes at the public examinations. If the energy of students had not been expended in memorising text-books and in leaping over the murderously high hurdles academically named public examinations, but had been conserved and directed towards developing independent thinking, promoting the spirit of independent enquiry and fostering small pieces of independent work in the laboratories, the Madras colleges should have produced more scientists, more scholars, more statesmen and more jurists, whose collective accomplishments would be the true and lasting foundation of their traditions. The tradition of an institution as an asylum of higher teaching of text-books is one thing; the tradition of an institution as

a dynamic centre for extending and conquering the untrodden fields of knowledge is a totally different thing. It is gratifying that the Presidency College has entered upon this second phase of its evolutionary history, and in shaping its destiny, the prodigious industry and the unparalleled success of Sir Venkataraman and his brilliant school of research workers will afford an inspiring influence.

During the gay fortnight over which the festive celebrations extended, duly punctuated by scholarly speeches and amusing athletic exhibitions, ample opportunities must have occurred for the old graduates who have attained distinction and opulence to inspire confidence into the younger generation, by narrating personal anecdotes, and for the present students to discuss with their old predecessors, those intricate and difficult problems which must sooner or later confront them on their emergence from the sheltering wings of the college. We suspect that the young men might have been assured that industry would be their bread and attention their butter, while for inspiration for higher endeavour, they could at all times rely on the magnificent traditions of their institution and the splendid achievements of the older generation. While we admit on theoretical grounds that this attitude towards the stern and unbending realities of life, may be perfectly unimpeachable, we believe that there must have been a few contemplative minds in the festive gathering, who might have taken a more serious view of the fate and fortune of the large assemblage of young men and women who pass out of the college annually. To our mind the obligations of the older generation of graduates extend slightly beyond paying homage to their college and rendering tributes of praise in an impersonal fashion to its greatness. We hold the view that the old students constitute the stewards of the rising generation, and the personal contacts established at the social gatherings might take some tangible shape in solving their exigent and embarrassing problems. We do not suggest for a moment that the annual and occasional festive assemblies should resolve themselves into round-table conferences for seriously discussing problems of careers and unemployment; but we doubt whether educational institutions can reasonably accept the responsibility of admitting large bodies of young men and women and yet remain impassive to th[e] consequences of their efforts. Suppose w[e] grant that continuous improvement in the social organism must precede all solution o[f] the problem of unemployment, and that suc[h] an improvement is possible only when th[e] whole society is reorganised economically an[d] psychologically by incorporating mechanica[l] progress into its general framework, then the question remains as to who should direct and control the whole process of adjustment. Do the colleges and the Old Students' Associations have any share in the task of relieving the accumulation of society's functional disturbances, euphemistically called unemployment, which inevitably must result from the educational and technical expansion outstripping social progress and adjustment.

We have no direct means of ascertaining the intentions underlying the celebration of the Foundation Day of the Presidency College. Beyond the excellent official report of the Principal of the College and the delightful reminiscences contributed by a

few distinguished old graduates, has the College anything else left to remember the great event by? We hold the view that, apart from the statues and portraits of defunct professors being inspiring examples for the present students to emulate, and for the old students as objects of recollection of their own life in the college, similar statues and portraits of past graduates who were prodigies of intellect in their college days, and who in later life became the most distinguished ornaments of society, and who have rendered the most conspicuous service to the country in the departments of public life in which they had chosen to labour, must be far more stimulating to the successive generations of young men for increased exertions to shape and mould their character on the pattern and ideals of the lives of their eminent predecessors. We conceive that a statue or a portrait of men such as Raja Sir T. Madhava Rao, Sir K. Seshadri Aiyar, Sir P. S. Sivaswamy Aiyar, Sir C. Venkataraman and Sir C. P. Ramaswami Aiyar should by its presence galvanise the intellectual and social life of the students; and the beginning already made by the portrait of C. Vijayaraghavachariar being added to the College Gallery, will, it is hoped, be followed by the artistic records of other distinguished old graduates. The message of statues and portraits must, however, always be subconscious, unless there are authentic and full records commemorating the history of the originals, with such clearness of narration and elegance of language as would constitute them into the most perfect form of biographies. The Centenary celebration should have been the most appropriate occasion for the publication of such memorial volumes, and the Presidency College so full of culture and so full of great men, does not lack exponents of the former and portrayers of the latter.

'ASCU' WOOD PRESERVATIVE

THE spate of comment and enquiry that has reached us since the publication of the article on this subject in the previous number of *Current Science* is indicative of the widespread interest taken in and the rather nebulous position created by the withdrawal of *Ascu Record* by the Forest Research Institute, Dehra Dun. The relative facts can be stated in simple terms. When wood preservation was not part of the normal technique of timber utilisation in this country, Ascu was brought into being at Dehra Dun. The new process was considered to be of such promise that the Railway Board—one of the largest timber consumers in the country—appointed a Committee presided over by Sir C. V. Raman to examine the claims of Ascu. This Committee opined that the data then available, justified further experimentation. In the meantime, although the Forest Research Institute in their publications indicated some of the points requiring further elucidation, they definitely and even enthusiastically advocated the adoption of the process. Indeed, such was their confidence that so lately as in 1937 Sir Gerald Trevor, then President of the Forest Research Institute, in an article "Wood Preservative in India—Cresote *vs.* Ascu" summed up that in a choice between the two "the answer is in favour of Ascu every time"; this is very high praise to a wood preservative. As a direct result of

such recommendation, more than a score of Ascu plants are now operating in the country and it is to be added that in a majority of these cases, no form whatever of wood preservation was practised prior to the adoption of Ascu. The Forest Research Institute and Ascu are entitled to be congratulated for their part in this big step forward in Indian timber utilisation and conservation.

It is obvious that the withdrawal of the *Ascu Record* at this stage leaves the users of the process in a very difficult position. But this undoubted hardship inflicted on such users and the consideration which they are entitled to, should not blind one to the right which the Forest Research Institute has in revising its opinion on the basis of new and additional data. The Institute has not merely such right but as the premier Forest Research Institute of India, it is its simple duty to do so. We have no doubt that the Institute has collected all available data on the subject before coming to this present decision; that in fact it has satisfied itself that failures attributed to Ascu-treated timber are not traceable to faulty application of the process; that the experience and records of the several Ascu plants have been pooled and fully examined; that further experimental work suggested by the Raman Committee has, in fact, been completed; and lastly, that the originator of the process of Ascu was consulted and his comments and interpretations of the data assessed.

If, as we can justifiably expect, these steps have been taken prior to the withdrawal of *Ascu Record,* we believe that the publication of these data suitably edited would have gone a long way in strengthening the position of the Institute in this matter. Such a course would have been just and fair to the users of the process, to the inventor of the process, and lastly to the Forest Research Institute itself which, to begin with, sponsored the process.

Apart from these, the larger interests of timber conservation and utilisation in India necessitate other suitable action in this matter. The public in general are not likely to be aware that the ideal wood preservative has yet to be discovered, that this is partly because of our ignorance about the fundamental problems relating to the movements of liquids in timber and that, in the result, every preservative has its own peculiar merits and limitations. To complicate matters further, India is a land with many species of timber being used in a wide variety of climates possessing different fungi-flora and other wood destroying organisms. It is with this background that Ascu or any other process has to be judged. And such verdict, if it is to command public confidence, should be given by a body of experts who only would be able to interpret the available data in their correct perspective. We would therefore urge upon the Government of India the desirability of appointing such a committee to enquire into the whole history of Ascu. The findings of such an authoritative committee would help to determine the future course to be adopted by the present users of Ascu, who are now left in mid-air as it were, to restore public confidence in the recommendations of the Forest Research Institute, Dehra Dun, and to serve as a guide and a stimulus to intelligent timber utilisation and conservation in future.

COLLOID ASPECTS OF MILK TECHNOLOGY

BY

W. L. DAVIES

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MILK and cream are complex emulsions of amicronic butter-fat globules and micelles of a calcium caseinate-phosphate complex as the disperse phase, in an aqueous phase of sub-micronic protein molecules and lactose and salt solution. It is the purpose here to deal with the behaviour of such emulsions during the mechanical treatments involved in creaming, homogenising, whipping and churning, which are operations carried out in the manufacture of some milk products. Investigations of these processes in such natural and complex emulsions have added considerably to our knowledge of colloidal behaviour.

Milk fat globules.—The fat globules of milk vary in size from 0·2 to 22 μ in diameter; the average size is 3–4 μ, but size distribution curves show a major mode at 2 and a minor mode at 5 μ; the size distribution varies with age and breed of the cow and the stage of the lactation period. The process of homogenisation aims at reducing the size of the globules to 0·2–1·0 μ in diameter so as to obtain globules of uniformly small size within a confined small size-range. Whole milk contains $2\text{–}4 \times 10^{12}$ and homogenised milk $3\text{–}4 \times 10^{14}$ globules per ml.; homogenisation increases the fat surface area 100–120 times.

The fat globules in milk are stabilised by all the proteins of milk. The soluble proteins lower the surface tension and there is a considerable adsorption of all protein material on the fat globule surface. Most of this protein can be washed out of cream by repeated dilution with water and centrifuging. The ultimate protective colloid is a mixture of muco- and lecitho-protein, predominantly the latter. This protective scheme is the same as in other natural fat emulsions such as egg-yolk, crop milk of pigeons and in blood and lymph. The whole of the adsorbed protein layer may be looked on as the protective colloid in milk. This has been termed *slim membran* or haptogen membrane; it is the change in this layer by mechanical treatment which defines the behaviour of milk and cream in the manufacturing processes mentioned above.

Creaming of Milk.—When milk is allowed to stand, the fat globules rise against gravity to form a cream layer. Individual fat globules obey Stokes' law in this respect and the average rate of rise is 0·18 cm./hr. The fat has *d* 0·92 and the serum *d* 1·035 at room temperature. By raising the temperature, the difference between the *d* of fat and serum increases owing to the larger coefficient of thermal expansion of the fat. By using a cream separator, in operating which the force of gravity is multiplied × 1000, an almost instantaneous separation of cream can be brought about in milk at a temperature of 35–45° C. By adjustment, the fat content of the cream can be made to vary from 20–75 per cent.; that of the skim milk is about 0·05 per cent. and consists of globules less than 2 μ in diameter.

Of importance in the creaming of milk is the property of the fat globules to aggregate to form "clumps". In natural creaming these clumps rise as individual masses, thereby accelerating the process of creaming. The clumps are made up of thousands of fat globules and contain 50 per cent. of fat and have *d* 0·97. When creaming occurs with individual fat globules, a thin layer of cream of closely-packed globules with high fat content is formed; when this layer solidifies during storage it causes the defect known as "cream plug"; the layer is difficult to incorporate in the milk without first warming the milk. Creaming after clumping has occurred gives a thick cream layer of about 30–40 per cent. fat content. The clumps rise rapidly and their structure is such as to prevent packing, and the rigid condition of the semisolid fat globules prevents distortion of the clumps. A deep cream layer, or good "cream line" is important in the sale of bottled milk as it conveys the idea of richness to the purchaser. Since the heat treatment of milk tends to decrease clumping capacity, much attention has been paid to preserving the cream line in holder pasteurised milk. The best results have been obtained by not heating above 145° F., and cooling rapidly to 45–50° F. immediately after the heating period of 30 minutes,

Short "flash" methods of pasteurisation do not influence creaming capacity or the depth of cream layer.

Clumping of fat globules.—The importance of clumping rests in the fact that the process diminishes the amount of adsorbed material on the surface of the globules, so that it is released into the serum, and is available for the stabilisation of a second disperse (gaseous) phase introduced into the emulsion in the process of whipping and churning. Clumping occurs when fat globules come into contact with one another, or when smaller clumps collide. The aggregation simulates that of the aggregation of individual gas bubbles on the surface of a liquid when they collide; such aggregates (foam) have common boundary areas between each bubble, each bubble is distorted and the radius of curvature at the outside layer of bubbles is much greater than for an individual bubble. The clumps in milk are stable to mild mechanical treatment and indeed agitation favours clump formation. The optimum temperature for clumping is 6–8° C. when the fat is in a semisolid condition. Heating milk breaks up the clumps especially when agitated and this treatment may have a small homogenising effect. If milk is heated above 63° C. the tendency to clump when cooled is diminished owing to the partial denaturation of adsorbable material (lactalbumin). The addition of a protective colloid such as gelatin, gum arabic or tragacanth or homogenised milk causes the property of clumping to be restored.

Homogenisation of milk.—This process is usually carried out in milk to prevent cream rising, and to prevent the layer of cream churning during milk transport, and to prevent processed cream in jar or tin from churning. The process is carried out by forcing milk or cream through small apertures under pressures of from 500 to 3,000 lb./in.^{2} The fat globules divide and are immediately stabilised by protein membranes. The efficiency of homogenisation increases with rise of temperature, that of the commercial process being at 63° C., at which also the ability of the globules to aggregate is nil. To prevent any creaming in milk, pressures from 2,500–3,000 lb./in.^{2} are necessary. This produces globules less than 2 μ in diameter and finer than those remaining in separated milk. The smaller globules are less susceptible to forces of agglutination and thus do not rise to form cream. The amount of adsorbed protein is enormously increased; there is thus not sufficient protective colloid in the serum to protect a second disperse phase such as a gas and homogenised products will neither whip nor churn.

Whipping of cream.—Milk and cream foam readily when air is beaten into them. Cream can be whisked into a stiff foam by incorporating into it a second (gaseous) disperse phase in a fine state of division. A whipped white of egg is a simple picture of the conditions reached in whipped cream. By continuous whisking, air is broken up into small bubbles which are immediately stabilised by albumin adsorbed at the air/liquid interface; continued whipping breaks up the air globules to a finer state of division so that the degree of protein adsorption is such as to cause the albumin to precipitate as a solid at the interface (Ramsden phenomenon) which gives the foam rigidity and stiffness. In cream, the compositions of the phases are more complex. There must be sufficient adsorbable material to stabilise the gaseous phase and since this is not so concentrated as in egg-white the semisolid fat globules confer most of the rigidity on the whipped product. The variations in rigidity of whipped cream, such as a "soggy", partly whipped or product giving a drainage of serum, are due to incorrect fat content, incorrect temperature of conditioning the cream before whipping and lack of protective colloid. Cream of 35 per cent. fat conditioned at 8° for 16 to 24 hours is best for whipping.

Much confectionery cream is now made from cream reconstituted from butter and dried or whole milk. With dried milk, inferior whipping properties are given if the protein has been denatured by heat; spray-dried milk gives cream of good whipping properties. A small amount of gelatin as stabiliser enables all creams including homogenised cream to be whipped successfully. Reconstituted creams for whipping require low pressures only in the homogenising (or reconstituting) process and to be held at 8° C. for 16–24 hours for conditioning. In the holding period, the fat globules must attain a semisolid condition and aggregate into clumps; both conditions assist in giving rigidity and stability to the whipped product.

Ice cream manufacture.—Ice cream mixes are pasteurised before freezing. They contain added stabilisers such as gelatin or

dextrinised starches (up to 0·5 per cent.) to assist in the whipping process which is carried out early in the freezing of the mix. The homogenised mix thus incorporates in the freezing process an air phase equal to 80 to 120 per cent. of the volume of the mix (overrun); the gaseous phase is stabilised partly by milk proteins and partly by the added stabilisers.

Churning.—The churning of cream into butter is a mechanical process which proceeds beyond the whipped stage of cream described above until the aggregating of the fat globules is so intense and the demand of protective colloid by the gaseous phase so large that the emulsion breaks. In the churning process, the whipped condition is marked by the cream "going to sleep" in the churn; the breaking of the emulsion is marked by a dramatic change in the fluidity of the churn contents from a viscous mass to a mobile liquid.

Two theories have been advanced to explain the churning process. The *foam theory* (Rahn) takes into account the close-packing of the fat globules in the foam leading to fat clumps. The protein in the lamellæ of the foam gradually assumes a solid character until further churning destroys the structure and the foam collapses; this is followed by coalescence of the fat globules.

The *phase inversion theory* takes into account the gradual dehydration of protein at the fat/water interface which enhances the tendency to the formation of butter, and that the process reverses the type of emulsion.

A gaseous phase is essential to churning. A full churn with no air-space will not yield butter. The above two theories are related in that, in the foam theory, what happens in the destruction of the protective properties of the colloid is the dehydration of protein to such an extent that protein is precipitated so that its protective power in the emulsion is lost. When butter is formed as granules, the protective colloids appear in the serum (buttermilk). If synthetic creams are made by homogenising fat in separated milk, whey or buttermilk, only cream from buttermilk will churn completely. The stabilising factor and that taking part in churning are thus removed from milk in the cream but are liberated into buttermilk when the foam formed during churning breaks.

Methods of obtaining butter other than by churning support the foam theory. Converting milk into froth by means of streams of gas concentrates the fat in the foam from which butter may be obtained by collecting in a fine sieve. Boiling cream *in vacuo* at low temperature is a modification of the same process. The passing of cream and air through long tubes of fine bore and separating butter by sieving the liquid is another modification.

The structure of butter.—Butter is not strictly a water-in-oil emulsion; it is more complicated in structure and different types of butter vary in structure. The continuous phase is butter-fat in which are dispersed globules of fat, water and air, surrounded by the same protective colloid as the fat globules in cream. Of importance is the water content and the distribution of water in butter. Most countries have set a maximum legal standard of 16 per cent. of water in butter. By churning cream at temperatures higher than those usually used (9–12° C. in summer, 13–15° C. in winter) more moisture is incorporated in the butter and this cannot be reduced by working the butter. An inefficient conditioning of the cream has the same effect, while butter from cream in which the fat globules are still liquid is of high moisture and curd content and cannot be "worked" like ordinary butter. There are three phases of water in butter, (*a*) the water globules, which are buttermilk emulsified in fat, (*b*) films of water separating the butter granules and (*c*) small pockets of wash water. Butter from which water can be squeezed by pressure contains too much wash water.

The "working" of butter by corrugated rollers after churning has two effects, namely, pressing out wash water and increasing the amount of fat as the continuous fat phase. Overworking has the effect of increasing the amount of fat phase to such an extent as to give a greasy or "salvy" texture; the same effect can be produced by churning the butter to lumps in the churn instead of into granules of the size of lead-shot. The moisture incorporated into such butter is less (10–12 per cent.) than in properly-made butter, while leaky butter does not necessarily contain more moisture than well-made "dry" butter.

LETTERS TO THE EDITOR

Effect of Iron Content of Manganese Ores on Dry Cell Characteristics

Of all the impurities that may be found in the manganese ore used in compounding the depolarizer mixtures for dry cell manufacture, iron has perhaps received the greatest attention, yet little is known about the exact manner in which iron may affect the performance of a cell when present in different chemical and physical forms.

Opinion is agreed that metallic iron, being electropositive to zinc, if present in the cell, will set up local currents in such a direction as to dissolve the zinc and cause the cell[1] to deteriorate. Care is therefore always taken to ensure that no metallic iron finds its way into dry cells. Similarly, ferrous iron, being partially soluble in the electrolyte, may be reduced to the metallic state and deposited on the zinc container, thus leading to similar deterioration through local action.[2] The probability of ferrous iron being present in manganese dioxide ore, which is a strong oxidising agent, is, however, negligible.

Ferric iron which is almost invariably present in manganese ore, may exist in one or more of its various forms; thus it may be hydrated to various degrees of hydration, independent of or as part of the crystal structure of the manganese oxide in the ore, in combination with or independent of other impurities. It is important to know which of these forms are generally likely to be met with and what would be the influence of iron in such forms on the performance of dry cells in which they are present.

A large number of cells have been made and tested for their electrical characteristics in these laboratories during the past three years,[3] and a number of manganese ores of Indian and foreign origins have been chemically analysed and used in these investigations.[4] As a result of this work, it is now possible to begin to form some idea as to how iron present in combination with manganese dioxide may influence cell performance.

In Fig. 1 is plotted the average watt-hour outputs obtained from groups of cells made from different ores, under identical conditions,

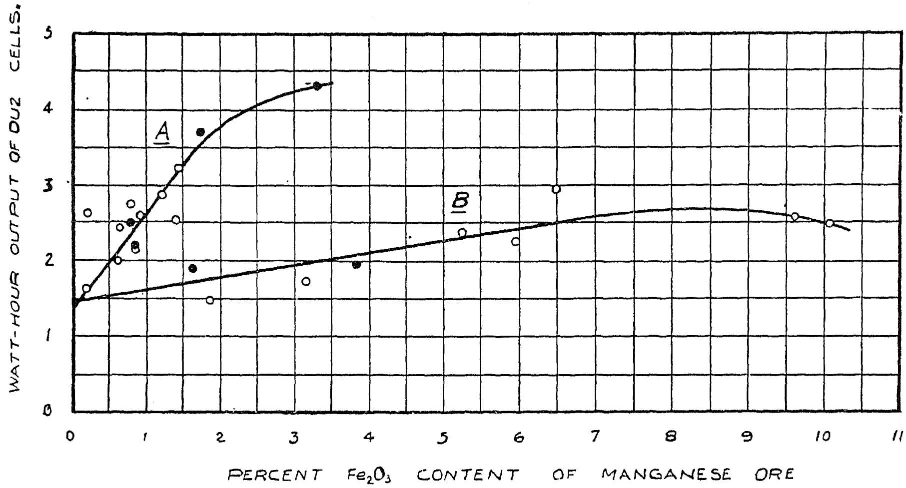


FIG. 1

against the iron contents of the ores expressed as ferric oxide. The two curves drawn show that all the ores examined may be roughly divided into two groups, *A* and *B*. It will be observed that these groups clearly have one characteristic in common, namely, that the output of the cells increases, in general, with increasing percentage of iron in the ore, though this fact cannot easily be reconciled with the general opinion held in the past by dry cell manufacturers.[5] Both curves show, however, a tendency to flatten out at high iron content values, which indicates that in each group there probably exists a limit beyond which the beneficial effect of iron approaches a saturation value.

In group *A*, the iron content appears to have a much more pronounced effect on the output of the cells than in the case of group *B*. The slope of the initial part of curve *A* is equivalent to 1·18 watt-hours for each one per cent. of Fe_2O_3, while that of *B* is only 0·154, giving a ratio of effectiveness of the iron in *A* as compared with *B* of roughly 7·65. This marked difference in the behaviour of the two groups naturally raises the question as to the possible mechanism of the effect of the iron, but to answer this, however, a great deal of further work is necessary.

Conventional chemical analyses of the ores have hitherto thrown no light on the question, nor have the several attempts made in this laboratory and elsewhere at developing empirical analytical methods been very successful.[6] Petrological examination to determine the geological character of the ores is now in progress. X-ray crystal structure analyses may be required in order to answer satisfactorily the question raised. Having learned more about the exact nature of the mechanism, it may then be possible to improve certain types of ores by suitably modifying their ferric oxide contents.

Of the 23 ores for which data has been plotted in Fig. 1, 17 are of Indian origin (plotted as hollow circles) and 6 are from foreign sources (plotted as full circles). All these ores, when admixed with 10% of artificial manganese dioxide, were improved considerably in regard to watt-hour output, in certain cases this improvement amounting to as much as 1·4 watt-hours.

L. C. VERMAN.
K. SUBBA RAMAIAH.
G. D. JOGLEKAR.

Industrial Research Bureau,
Alipore, Calcutta,
January 31, 1940.

[1] *Guiding Principles of Battery Manufacture*, Nikolaus Branz, Berlin, Book No. 3, pp. 59–61, 84–85.

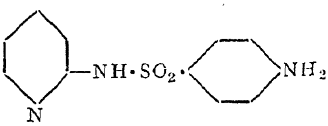
[2] *Ibid.*, pp. 79–80 ; also see 6.

[3] Verman and Joglekar, *Curr. Sci.*, 1939, **8**, 332.

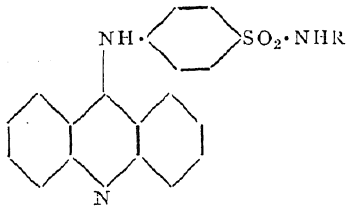
[4] Naidu and Joglekar, *Proc. Ind. Sci. Cong.*, 1938, 98 ; Joglekar, Subba Ramaiah, Naidu and Verman, *ibid.*, 1939, 86.

[5] Coggin Brown, *Bull. Ind. Industries & Labour*, No. 2, 1921.

[6] Droteschmann, *Chem. Ztg.*, 1938, **62**, 216.



(I)



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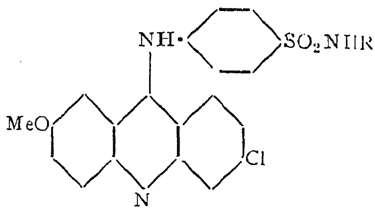

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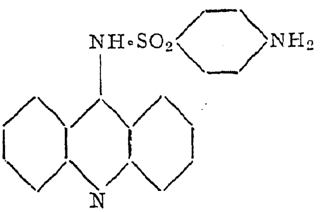
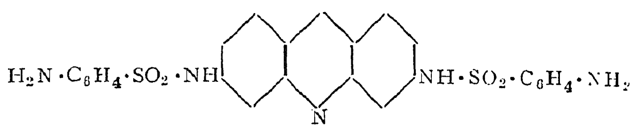
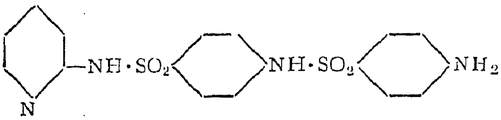


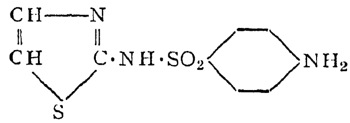
(IV)



(V)



(VI)



(VII)

derivatives of 4-aminobenzene sulphonanilide, and 2-N[1] sulphanilamidopyridine (I), using phenol as the condensing agent. 9-Aminoacridine 2:8-diaminoacridine, 2-N[1] sulphanilamidopyridine (I) and 2-aminothiazol condensed with *para* acetaminobenzene sulphochloride (in acetone and pyridine) and the products hydrolysed with sodium hydroxide (2·5N) or hydrochloric acid (4-5N) yielded respectively 9-N[1] sulphanilamidoacridine (IV), 2:8-di-N[1] sulphanilamido acridine (V), 2-(4-N[1] sulphanilamidobenzene sulphonamido)-pyridine (VI) and 2-N[1] sulphanilamidothiazol (VII).

The synthesis of the last mentioned compound has been independently reported by Fosbinder and Walter.[2] These compounds have been tested in some experimental bacterial infections in mice and the results will be published elsewhere.

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B. K. NANDI.

Haffkine Institute,
Parel, Bombay,
February 12, 1940.

[1] Ganapathi, *Indian J. Med. Res.*, 1940, April issue (under publication).
Proc. Ind. Acad. Sci. (under publication).
Gray, *J. Chem. Soc.*, 1934, p. 1202.
[2] Fosbinder and Walter, *J. Amer. Chem. Soc.*, 1939, **61**, 2032.

Permanence of the Hysteresis Loop in Sorption

SEVERAL interesting phenomena, such as, the drift[1] of the hysteresis loop and the disappearance[2, 3] of the hysteresis loop, accompanying the successive sorptions and desorptions of water vapour on various colloids have been presented by the author. The remarkable permanence and reproducibility of the hysteresis loop in the sorption of water on alumina gel are presented in this note.

Alumina gel was prepared as previously described.[4] In spite of the washing of the precipitate of gelatinous alumina, till the wash water was free from sulphate, the gel was found to retain some sulphate. The dried gel was activated by heating it for two hours to 950° C., which has been found to be the optimum temperature[4] of activation for getting alumina gel of maximum sorptive capacity. The gel was degassed in vacuum (10^{-4} mm.) for five hours and a series of sorptions and desorptions of water vapour at 30° C. were conducted with the aid of a sorption spring balance, and the results are shown in Fig. 1. A period of nearly two months elapsed between the commencement of first sorption and completion of tenth desorption.

The hysteresis loop obtained remains permanent and reproducible even after a series of sorptions and desorptions. The second, third, fourth and tenth hysteresis loops are all identical (Fig. 1). Such a reproducible hysteresis

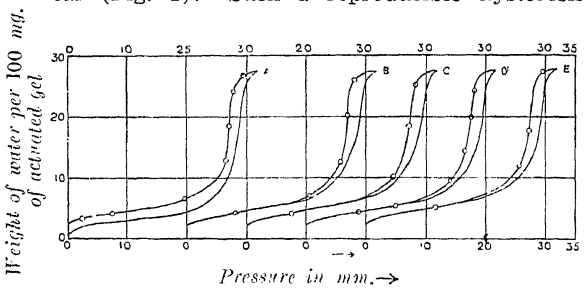

FIG. 1

A. First sorption ●—●—● and desorption ○—○—○
B. Second ,, ,, ,, ,,
C. Third ,, ,, ,, ,,
D. Fourth ,, ,, ,, ,,
E. Tenth ,, ,, ,, ,,

effect is satisfactorily explainable on the basis of the cavity concept[5] which has been established to be the general cause[6] of hysteresis in sorption.

In all porous adsorbents, there are capillaries of varying shapes and dimensions. Of these capillaries some are open pores and some are cavities with narrow necks. An open pore is produced by three spherical particles in juxtaposition. A close packing of four spherical particles, however results, in addition to open pores, in a cavity with narrow necks. The sorption of vapours of liquids in a porous adsorbent comprises the condensation of the vapour in these capillaries, as well as monomolecular adsorption on the surface. The latter process will ordinarily be complete at comparatively low pressures. Hysteresis in sorption (*i.e.*, the non-coincidence of the sorption and desorption curves) indicating the retention, for the same vapour pressure, of a larger amount of the adsorbate during desorption than during sorption, usually appears in the later stages of sorption, when capillary condensation sets in. A permanent and reproducible hysteresis effect is obviously connected with the process of filling and emptying of the capillaries. Sorption is mainly a case of filling and desorption of emptying of the capillaries. During the filling as well as the emptying of an open pore, the liquid miniscus will be up to the same pore radius and the position of the miniscus depends upon the vapour pressure and consequently, the amount of the liquid retained is the same whether it is sorption or desorption. In the case of a cavity, however, the difference sets in. During sorption, the cavity gets progressively filled up in the same way as the open pore, but during desorption, the completely filled cavity is not emptied unless the vapour pressure is lowered below the minimum at which the liquid in the widest neck of the cavity is just in equilibrium with the vapour. Just below this minimum pressure, the cavity is completely emptied. So during sorption there is the possibility of a cavity being partially filled but during desorption, there can be no partial emptying and the cavity remains either completely filled or completely empty. In this way a porous adsorbent can always retain larger amount of the adsorbate during desorption than during sorption. The hysteresis loop originating from such a process of filling and emptying of a cavity must remain permanent and perfectly reproducible any number of times and alumina gel just like titania[6] and silica[7] has shown a hysteresis loop of remarkable permanence and reproducibility in the sorption of water.

Why a cavity filled with a liquid is not emptied even though the vapour pressure is considerably reduced below what is just sufficient for complete filling of the cavity is a problem which remains to be elucidated. At the reduced pressure the liquid in the cavity should have boiled away according to normal equilibrium condition, but it is permanently held in a metastable equilibrium. This is obviously a case of superheating, but the actual mechanism is obscure.

Like silica,[7] titania[6] and ferric oxide[1] gels, alumina retains 2·6 per cent. of water irreversibly at the end of first desorption and this remains practically unaltered in the subsequent

sorptions and desorptions. This water is probably locked in the interstices of the gel, or held on the surface as OH attached to alumina, as in the case of silicic acid described by Rideal.[8] The sorptive capacity at saturation pressure is 27·5 gm. of water per 100 gm. of the activated gel. The sorption isotherm, like those of titania gel-water,[6] ferric oxide gel-water[1] and copper oxide-water[9] systems exhibits during the later stages of sorption, a rapid rise in the sorptive capacity with vapour pressure, there being a clear inflection in the curve. Such an inflection marks a transition from monomolecular adsorption to capillary condensation. The major portion of the capillary volume is approximately between the relative vapour pressure limits of 0·82 and 0·94 and these correspond to capillary radii of 51 Å and 160 Å respectively as calculated from Lord Kelvin equation.[9, 3] The tail-end of the hysteresis loop terminates at a relative vapour pressure of 0·47. This corresponds to 13·5 Å which is the smallest neck-radius of the cavities in the sample of alumina gel. The peak of the hysteresis loop extends up to the saturation point indicating that some of the cavities in the porous alumina gel are of microscopic dimensions.

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Department of Chemistry,
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February 3, 1940.

1 Rao, K. S., *Curr. Sci.*, 1939, 8, 546.

2 ———, *Ibid.*, 1939, 8, 256.

3 ———, *Ibid.*, 1940, 9, 19.

4 —, and Rao, B. S., *Proc. Ind. Acad. Sci.* (A), 1936, 4, 562.

5 McBain, *J. Amer. Chem. Soc.*, 1935, 57, 699.

6 Rao, K. S., *Curr. Sci.*, 1939, 8, 468.

7 ——, Unpublished.

8 Rideal, *Trans. Farad. Soc.*, 1936, 32, 4.

9 McBain, *The Sorption of Gases and Vapours by Solids*, George Routledge & Sons, Ltd., London, 1932, 442, 433.

Rate of Sorption in Relation to Hysteresis

THE cavity concept[1] has been a remarkable success in the attempt to explain a variety of interesting phenomena, such as the permanence,[2] the drift,[3] and the disappearance[4] of the hysteresis loop in sorption. The simple idea of a cavity having narrow necks finds further support from the results of a study of the rates of sorption of water vapour on gels of silica, titania, alumina and ferric oxide.

The quartz fibre spring technique was employed in the work. The preparation of gels of silica,[5] alumina[6] and ferric oxide[6] has been described elsewhere. Titania was prepared by adding excess of ammonium hydroxide to a solution of titanium tetrachloride in hydrochloric acid. The precipitate was washed and dried. The gels of silica, titania, alumina and ferric oxide were activated by passing dry air through the gels heated to 450° C., 300° C., 950° C. and 200° C., respectively. The gels were degassed in vacuum (10^{-4} mm.) for five hours and a series of sorptions and desorptions of water vapour at 30° C. were conducted. All the four gels exhibited hysteresis. After the 3rd, 30th and 10th cycles of sorption and desorption the rates of sorption of water on gels of silica, titania and alumina respectively were measured. With ferric oxide the rate was measured in the 9th sorption. The 3rd, 30th, 10th and 10th hysteresis loops obtained with these gels of silica, titania, alumina and ferric oxide respectively have been shown in Fig. 1. By exposing the evacuated gel to water vapour at saturation pressure at 30° C. the extent of sorption with time was measured. The results are shown in Fig. 2.

All the four gels retain definite amounts of water irreversibly at the end of first desorption and these amounts remain practically unaltered in the subsequent cycles (Fig. 1). The rate of sorption is measured only in respect of the water reversibly held by the gel. Excepting the case of silica, the sorption isotherms indicate a clear inflection which marks a transition from monomolecular adsorption to capillary condensation. It is obvious from the

diagram, that the major portion of the sorbed water is held in the capillaries. So the rate

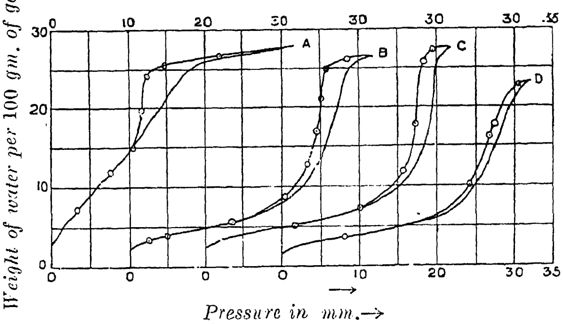

FIG. 1

A Hysteresis loop in Silica gel-water system
B. ,, ,, Titania gel-water ,,
C. ,, ,, Alumina gel-water ,,
D. ,, ,, Ferric oxide gel-water ,,

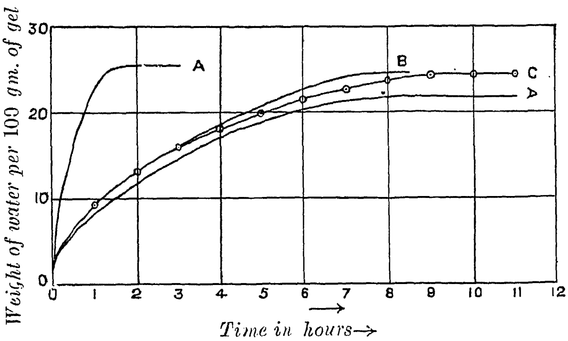

FIG. 2

A. Rate of sorption of water on Silica gel
B. ,, ,, ,, Titania gel
C. ,, ,, ,, Alumina gel
D. ,, ,, ,, Ferric oxide gel

of sorption is mainly the rate of filling of the capillaries. Moreover the nature of the surfaces of these gels in relation to water is practically the same, there being no possibility of any specific influence. The amounts of sorption of water at equilibrium, per 100 gm. of gels of silica, titania, alumina and ferric oxide are 25·4 gm., 24·6 gm., 24·5 gm. and 21·8 gm. respectively. Barring the case of ferric oxide, the amounts of sorption do not appreciably differ. But the time intervals for the completion of sorption are markedly different. Silica gel requires only 2 hrs. for the attainment of equilibrium, whereas titania, alumina and ferric oxide gels require approximately 7½ hrs., 9 hrs., and 9 hrs. respectively. The relatively short interval of time (2 hrs.) in the case of silica gel indicates a greater ease of filling of the capillaries in silica. This difference in the rate of filling is obviously connected with the shape of the capillaries. Of the two distinct types of capillaries namely the open pore[2] and the cavity[2] with narrow necks, the latter requires longer time for filling. The process of sorption is essentially the creeping of the condensed liquid through the narrow necks into the cavity. So the differences in the rates are solely to be attributed to the differences in the numbers and sizes of the cavities in the porous gels.

Of the sorption and descorption curves, the portions forming the hysteresis loop denote the different radii of the cavities in the one case and of necks in the other. In silica gel, the cavities and the necks are very much smaller than in the other gels. The hysteresis loop tapers away beyond a relative vapour pressure of 0·6 and this corresponds, as calculated from Lord Kelvin equation,[7] to a radius of 20 Å which can be taken to be approximately the maximum cavity radius. But in the other gels, there are cavities of microscopic dimensions as indicated by the hysteresis loop reaching the saturation point. These facts go to show that in silica gel there is a larger number of comparatively small cavities than in titania or alumina gels, the total cavity volume being approximately the same in all these gels.

As regards the spatial arrangement of the open pores and cavities, it is probable that these are interlinked with one another. Such an arrangement results in a series of channels having a large number of constrictions.

The rate of sorption is the rate at which the liquid condensed in the neck creeps into the interior of the cavity. This is dependent upon the difference between the outside vapour pressure, which in the present case is constant (the saturation pressure of water at 30° C.) and the pressure of the vapour in the interior of the cavity. The vapour pressure inside increases as sorption proceeds. In small cavities, comparatively small vapour pressure prevails. Therefore the effective

driving force, during the filling of smaller cavities, will be greater than during the filling of bigger cavities. Hence the more rapid filling of smaller cavities than of bigger ones. In fact in big cavities of microscopic dimensions, the effective driving pressure falls off, and becomes negligible during the last stages of sorption and in consequence the rate of filling of the cavities that are yet partially filled becomes extremely slow. Silica gel containing much smaller cavities than the other gels is filled up more quickly and the rate of sorption of water on silica gel is very large compared with those on other gels. There are yet certain unsolved problems, such as the shape of the cavities in gels, the total number of cavities, the number of cavities having particular neck and body-diameter and these problems await solution.

KITTUR SUBBA RAO.

Department of Chemistry,
Central College,
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February 3, 1940.

[1] McBain, *J. Amer. Chem. Soc.*, 1935, **57**, 699.
[2] Rao, K. S., *Curr. Sci.*, 1940, **9**, **68**.
[3] ———, *Ibid.*, 1939, 8, 546.
[4] ———, *Ibid.*, 1939, 8, 256 ; 1940, 9, 19.
[5] Rao, B. S., and Ross, K. S. G., *J. Phys. Chem.*, 1931, 35, 3486.
[6] Rao, K. S., and Rao, B. S., *Proc. Ind. Acad. Sci.*, (A), 1936, 4, 562.
[7] McBain, *The Sorption of Gases and Vapours by Solids*, George Routledge & Sons, Ltd., London, 1932, 433.

A Rapid Volumetric Procedure for Analysis of Lead-Tin-Antimony Alloys

THE methods described in the literature for the analysis of such alloys are tedious and often require special apparatus.

The following procedure developed in these laboratories has been found to be convenient and rapid.

The lead content of the alloy is estimated as follows: The precipitate of lead sulphate obtained according to the usual procedure is digested with a known excess of 0·5 N solution of sodium carbonate, to effect its decomposition. The amount of sodium carbonate used up is ascertained by titration of the filtrate with standard HCl. The procedure suggested by Tananæff[1] was modified for the above purpose, and estimating lead whether in the presence or absence of tin and antimony could be carried out with good results as can be seen from the table.

Of the various methods available for estimation of antimony the potassium bromate method was found to be the most satisfactory. The details of the results obtained by other methods are not included in this communication. For the estimation of tin in the alloy the most convenient procedure was found to consist in the reduction of the solution with coarse antimony powder prior to titration with standard iodine solution. It was found that good results were obtained if 40–60-mesh antimony powder was employed for the reduction process, and that much coarser or finer material lead to erratic results.

The various procedures outlined above were applied to the analysis of four alloys of known composition prepared in these laboratories, by fusion of the pure metals in the right proportions in a vacuum furnace. The results obtained are given below:

Alloy No.	Lead %	Antimony %	Tin %
1	89·2 (89·0)	8·68 (8·75)	2·28 (2·25)
2	80·5 (80·5)	14·63 (14·75)	4·83 (4·75)
3	70·4 (70·5)	19·15 (19·25)	10·30 (10·25)
4	57·1 (57·22)	25·0 (25·17)	17·84 (17·61)

The figure given in brackets in the above table indicate the true percentages as calculated from the quantities employed for preparation of the alloys. It is clear from the above table that satisfactory results were obtained with alloys of a fairly wide range in composition.

My best thanks are due to Dr. K. R. Krishnaswami for suggesting the problem and advice during the course of this investigation.

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Indian Institute of Science,
February 15, 1940.

[1] Tananæff, *Z. anal. Chem.*, 1935, 100, 394.

Estimation of Gold in Cyanide Solutions

SEVERAL methods are available for the routine control-assays of the gold content of cyanide solutions, but none of them are suited to rapid work.

The following procedure developed in this laboratory is simple and rapid.

A quantity of the cyanide solution containing 50–100 mg. of gold is diluted to 50–100 c.c. and 2–3 g. of thin zinc turnings added. Then 20 c.c. of H_2SO_4 (1 : 1) is slowly added in 5 c.c. portions at intervals of 5 minutes. After the reaction slows down 10 c.c. of H_2SO_4 (1 : 1) is again added and the solution boiled for half an hour to complete the precipitation of gold. The precipitate is washed thoroughly with water by decantation and then digested with 10 c.c. (1 : 2) HNO_3 on the water-bath. The residual gold is well washed, dried, annealed and weighed in the usual manner.

A set of representative results obtained by this method is given in the following table:—

Au taken mg.	Au found mg.	Error per cent.
130·12	130·20	+0·06
130·12	130·06	−0·4
78·00	78·04	+0·05
72·88	73·93	+0·07
50·12	50·09	−0·06

Sets of parallel determinations were carried out by the Chiddy Method observing all the precautions and the results obtained were in good agreement.

The method outlined above is simple and rapid, and sufficiently accurate for most purposes.

In conclusion, I wish to express my grateful thanks to Dr. K. R. Krishnaswami, D.SC., F.I.C., for his keen interest and constant encouragement during the course of this work and for much helpful criticism.

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January 29, 1940.

Chromosome Numbers in Safflower (*Carthamus tinctorius* Linn.)

CHROMOSOME numbers in this species have been reported to be $2n = 20$ in Coimbatore types (Gregory)[1] and $2n = 24$ in Pusa type 24 (Patel and Narayana)[2] and Pusa types 1 and 27 (Gregory).[3]

In the present investigation Somatic Chromosomes on the metaphase plates were examined from the root tips of the following material.

(1) Cawnpore type 39.

(2) Cawnpore type 59.

(3) Local Selection (Central Provinces) No. 1.

(4) Local Selection (Central Provinces) No. 7.

(5) Local Selection (Central Provinces) No. 52.

Twenty-four chromosomes were observed without any exception. Variability within the individual chromosome sets with respect to the size, shape and attachment-constriction of the chromosomes is well marked (Figs. 1 and 2).

Meiotic chromosomes were examined from the permanent smear preparations. The material used in these preparations was the local mixture. Twelve bivalents were distinctly observed at 1 metaphase (Fig. 3).

The senior author is indebted to the Imperial Council of Agricultural Research for financing the Oil Seeds Research Scheme, Nagpur, where this work is being carried out.

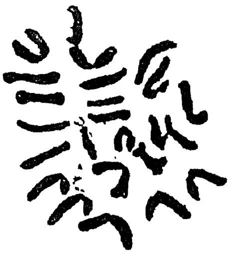

FIG. 1

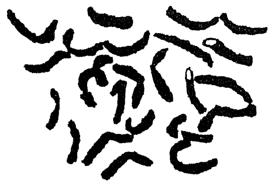

FIG. 2

FIG. 3

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Agricultural Research Institute,
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December 8, 1939.

[1] Gregory, P. J., *Proc. Ind. Acad. Sci.*, 1935, **1**, 763.
[2] Patel, J. S., and Narayana, G. V., *Curr. Sci.*, 1935, **4**, 412.
[3] Gregory, P. J., *ibid.*, 1935, **4**, 412.

A Preliminary Note on Interspecific Hybridization and Use of Colchicine in Cotton*

(1) INTERSPECIFIC HYBRIDIZATION BETWEEN NEW WORLD AND ASIATIC COTTONS

THE Interspecific Hybridization work on cotton being carried out at this Station has shown that:—

(*a*) The F_1 hybrids between New World ($n = 26$) and Asiatic ($n = 13$) cottons are possible if large-scale crossing is done. The hybrids are self-sterile as usual.

(*b*) The backcrossing of these F_1 hybrids to New World parents only has given stray success in boll setting on F_1's. Such bolls contain very few seeds and plants raised therefrom give varying degrees of fertility—ranging from sterility to complete fertility.

(*c*) The progeny of these first backcrosses show marked fertility in some cases, with New World plant characters predominating. They, however, possess a few genes from the Asiatic parents, and their behaviour for adaptability together with combination of economic characters under Surat conditions is being further studied.

(2) EXPERIMENTS WITH COLCHICINE

(*a*) Trials were being made to induce doubling of chromosomes in sterile hybrids by various means, *viz.*, callus formation, chloroform treatment, etc., but all proved unsuccessful. At this stage of the work the discovery of colchicine as a potent weapon for inducing doubling of chromosomes was announced by Blakeslee and others. Experiments for the application of this alkaloid to cotton were therefore at once planned to find out the "threshold" value and were carried out in 1938–39 season. These showed that better results could be secured when germinating seeds were treated. Many plants were found affected with characteristic symptoms as described by Blakeslee, and results have been confirmed this year. Another method which has given success this year is the "drop method" of treating growing shoots of young seedlings, wherein it has been found that particular sectors are affected resulting in morphologically different branches possibly of polyploid nature.

(*b*) The characteristic symptoms of the affected plants and branches are:—

(1) Swollen cotyledonary stems, (2) Retardation of growth, (3) Broader leaf-lobes, (4) Prominent leaf veins, (5) Broader bracts, (6) Roughoid appearance with intensification of hairiness, (7) Bigger glands, (8) Bigger flowers, (9) Bigger pollen grain size, (10) Bigger seeds.

(*c*) The effect on various species and their crosses wherein colchicine effect is markedly visible is summarised below (see Table).

(*d*) It has been observed that there is a direct relation of the pollen grain size with the chromosome numbers in cottons and observations in these experiments show increase in pollen grain size due to colchicine treatment.

* This research is being financed by the Indian Central Cotton Committee.

Type	Effect on fertility		Effect on pollen grain size
	Normal	Colchicine treated	
G. herbaceum	Fertile	Sterile	Very defective bursting of anthers
G. arboreum	,,	,,	,,
G. hirsutum	,,	,,	,,
G. herbaceum × *G. herbaceum*	,,	,,	,,
G. arboreum × *G. arboreum*	,,	,,	,,
G. herbaceum × *G. arboreum*	,,	Stray setting	Bigger than in parents
G. herbaceum × *G. anomalum*	Semi-fertile	Semi-fertile	,,
G. arboreum × *G. anomalum*	Sterile	Fertile	,,
G. Davidsonii × *G. anomalum*	,,	,,	,,
G. hirsutum × *G. herbaceum*	,,	,,	Bigger than in *G. hirsutum* parent

That this effect is due to polyploidy remains to be confirmed by actual cytological study. The last three cases are of particular interest, inasmuch as the ordinarily sterile hybrids have been made fertile and more so because specially affected shoots on them show boll bearing while the rest continue to be sterile. These effects seem to be due to polyploidy induced by colchicine treatment resulting in harmonious chromosome pairing giving balanced viable gametes.

(*e*) It seems that the use of colchicine in cotton will open up a wide field for further research for exploiting the economic possibilities of polyploidy, by way of building up economically superior tetraploids from Asiatic cottons, or higher polyploids from New World and Asiatic combinations, or building up tetraploids which may be useful in bridging the wide gulf between the two groups of cotton differing widely in economic characters and in chromosome numbers.

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Agricultural Research Station,
Surat,
January 18, 1940.

A Note on the Deposition of Palmitic Acid from Cotton-Seed Oil

DURING the course of an investigation in progress in these laboratories relating to cotton-seed products, large quantities of cotton-seed (*Gossypium herbaceum*) oil obtained by extraction of the seeds with light petroleum, were stored. It was noticed that even at the temperature of the laboratory (25–30° C.), a solid began to be deposited and its bulk increased with time. The solid deposit which was allowed to accumulate for about four months, was separated from the oil under suction and the residue on the filter-paper washed a number of times with cold alcohol to remove as much of the liquid fatty acids as possible. The solid residue left on the filter-paper was recrystallised and examined. The melting point, the nature of the crystals and other properties indicate that the solid is a pure sample of palmitic acid. From the acid value and the saponification value the molecular weight comes to about 256·5 and hence its identity was confirmed.

The oil sample was also noticed to be very rancid and to have a high acid value. The acid

value of the fresh oil was 21·6 while the acid value after four months was 81·20. The solid is, therefore, a product of the hydrolysis of the glycerides. It has been observed that the free acids in rancid fats and oils have the same composition as the mixed fatty acids.[1] In cotton-seed oil, the major portion consists of the glycerides of linolic (41·7 per cent.), oleic (35·2 per cent.) and palmitic (20·0 per cent.) acids. The fact that pure palmitic acid is deposited could be explained as due to the circumstance that the other free fatty acids are retained in solution by the oil.

Though reference has been made to this deposit by previous workers,[2,3,4,5] the exact nature of the solid has not been definitely mentioned so far. Our observation that palmitic acid, in an almost pure condition, separates out from the oil is significant and supports the view that there is very little of stearic acid, if present at all.

The remarkable difference between solvent-extracted oil which becomes rancid and deposits palmitic acid so quickly as compared with oil obtained by expression, may find explanation in their very different Gossypol contents; the former contains small quantities, whereas the latter brings along with it considerable amounts. Gossypol is a good antioxidant and inhibits rancidity to a high degree.

V. Krishna Murty.
C. J. Dasa Rao.

Department of Chemical Technology,
Andhra University, Waltair,
December 28, 1939.

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[1] Hilditch and Jones, *J. Soc. Chem. Ind.*, 1931, **171**, 1. — —, Ichapuria, *J. Soc. Chem. Ind. Trans.*, 1938, 45.

[2] Hehner and Mitchell, *Analyst*, 1896, **21**, 328.

[3] Victor J. Meyer, *Chem. Zeit.*, 1907, 794.

[4] Jamieson and Baughman, *J. Amer. Chem. Soc.*, 1920, 1204.

[5] Lewkowitsch, *Technology of Oils, Fats and Waxes*, Vol. II, p. 204.

Variations in the Quality of the Pongamia Oil with Reference to the Occurrence of Karanjin

It has been shown that Karanjin exhibits the properties of the pongamia oil in regard to its effect on skin affections and hence it may be considered to be the active principle of the oil. In the course of our study we have found that it could be obtained readily in a pure condition by extracting the fresh oil[1] (pressed), and the yield is usually about 0·8 to 0·9 per cent. A sample of the oil obtained by solvent extraction yielded a mixture of karanjin and wax.

Examination of genuine samples of pongamia oil, obtained from different places during different seasons of the year, showed considerable variation in the yield of karanjin. One sample obtained in December from the West-coast was remarkably deficient in the active principle. This was at first attributed to variations arising as a result of differences in habitat. A sample of the oil pressed in Waltair and giving a good yield of karanjin also failed to give any karanjin after a storage of five months. The sediment deposited at the bottom of the container, however, contained all the karanjin. The occurrence of karanjin in the deposit along with zinc salts of fatty acids has been noted previously by Manjunath and Rao.[2] We have now found that the entire quantity which was originally present in the oil could be recovered from this source. The precipitation seems to be slow and may be accompanied by some change in the oil which lessens the solubility of karanjin. When the clear oil is then separated, it is devoid of karanjin. This fact should be noted by all those who use pongamia oil for therapeutic purposes.

N. V. Subba Rao.
T. R. Seshadri.

Department of Chemical Technology,
Andhra University,
Waltair,
January 30, 1940.

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[1] N. V. S. Rao, J. V. Rao and T. R. Seshadri, *Proc. Ind. Acad. Sci.*, 1939, **10**, 65.

[2] Manjunath and Rao, *J.I.C.S.*, 1938, **25**, 653,

Effect of Indole-acetic Acid on Rooting in *Gootes* (Marcotte) of Mango

The present method of inarching of mango using seedling stock is tedious and does not give satisfactory result. In this connection our attention has been drawn to a note by P. K. Sen,[1] who reports the result of his not very successful attempt to induce formation of roots in mango cuttings by treatment with indole-acetic and indole-butyric acids. As the period of his observation extended up to sixty days, the author concludes that the interval is too short for rooting in mango.

In the course of our trials to find out a more suitable method of mango propagation we tried to grow roots by ring bark cutting with treatment of indole-acetic acid employing two-year old shoots. After the ring bark was taken out as in the usual process, the epidermis of the bark just above the ring was slightly disturbed; the wound was thoroughly washed with water and then a lanoline paste containing 1 per cent. indole-acetic acid was applied round the stem above the ring to the extent of half an inch. It was allowed to remain in that condition for twenty-four hours after which it was dressed with coir only and kept moist. Control experiments were also undertaken in order to be certain of the effect of indole-acetic acid on the root formation in mango.

Roots were found in the treated region within six weeks of the experiment (Fig. 1). There was no rooting in the control plants (Fig. 2).

FIG. 1

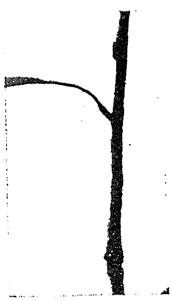

FIG. 2

The work is being continued and the detailed account of the investigation will be published in the *Transactions of the Bose Research Institute.*

A. GUHA THAKURTA.
B. K. DUTT.

Bose Research Institute,
Calcutta,
January 19, 1940.

[1] Sen, P. K., *Curr. Sci.*, 1939, 8, 553.

The Occurrence of Pollen Grains in the Ovary Wall of *Dianthus*

In *Dianthus*, a number of abnormalities are known to occur, but the one observed by the writer has so far not been reported.

An abnormal pistil having a deep longitudinal groove (indicating a slight bulging out of the carpels) on the ovary was collected, and in order to see how far the lobes of the ovary resembled as regards ovule development, it was fixed and microtomed in the usual way. In Master's Teratology, it is mentioned that in abnormal ovaries of *Dianthus*, with a disunion of the carpels, the ovaries are mostly destitute of ovules.

In serial transverse sections of the abnormal ovary that was collected, it is seen that the smaller lobe is composed of one carpel, and the larger one of two carpels, both the lobes containing normal, fully developed ovules. The larger lobe is bilocular at the base, but towards the middle of the ovary free-central placentation is established due to the breaking down of the septa. The smaller lobe is unilocular throughout and has marginal placentation.

From about 2·5 mm. above the base of the loculi of the ovary, a small cavity makes its appearance in the ovary wall of the smaller lobe, almost directly opposite the place where the smaller lobe is continuous with the larger (Fig. 1). This cavity gradually enlarges in size, and contains fully developed pollen grains, some of them entirely normal in appearance, and others deformed (Figs. 2 and 3). This part of the ovary wall containing pollen grains higher up bulges into the loculus of the ovary. Towards the middle of the length of this pollen cavity, it opens by a narrow aperture into the ovary

(Fig. 4), but towards its apex it again closes up. The length of this pollen cavity is about

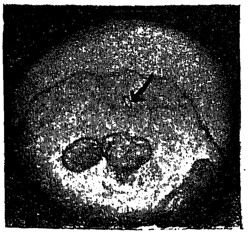

FIG. 1

FIG. 2

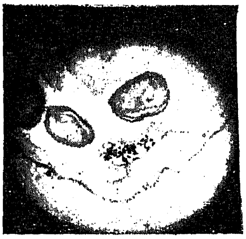

FIG. 3

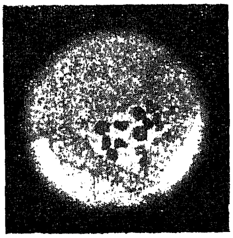

FIG. 4

4·5 mm. and it is divided into three linear parts by two constrictions and sterile tissue. The extreme tip of the "Pollen cavity" is separate from the ovary wall and lies in the loculus of the ovary. The vascular bundles of the ovary show no relation, either direct or indirect, to this pollen cavity, while the filaments of the normal stamens of this plant are supplied with well-developed vascular strands.

Similar development of microsporogenous tissue in the ovary has been previously recorded in Salix.[1, 2]

I am deeply obliged to Dr. A. C. Joshi, D.SC., of the Benares Hindu University, for kindly going through the manuscript and giving valuable suggestions which have been incorporated in this note. I am also grateful to Dr. N. N. Murti, PH.D., for kindly providing me with all facilities for research, and for the keen interest he had taken in the work.

V. S. RAO.

Department of Biology,
Ramnarain Ruia College,
Matunga,
January 26, 1940.

[1] Chamberlain, C. J., *Bot. Gaz.*, 1897, 23.

[2] Hagerup, O., *Danske Vidensk. Selsk. Biol. Med.*, 1938, 14.

The Duration of the Parasitic Stage in the Life-history of the South Indian Fresh-water Mussel

WE have no knowledge of the life-history of any of the Indian Unionidæ or fresh-water mussels. This is partly due to the difficulty of observation, the important phase in the development of the mussel being passed as a parasite on a suitable fish-host. During this stage the 'encysted' glochidium metamorphoses into the juvenile mussel, attaining complexity of organisation without increase in size. In nature, the infection of fish is purely accidental, and specimens of infected fish are hardly come across. Experimental determination of the appropriate fish-host by artificial infection may involve several trials with different species of fish.

Quite recently, employing the method of artificial infection, I was able to observe the metamorphosis of the 'encysted' glochidia of *Lamellidens consobrinus* (Lea). The remarkable feature in the life-history of this form is the very short duration of the parasitic stage. For the European and American species the duration of the parasitic stage is stated to be from a few weeks to two months or longer.[1] In the case of *Lamellidens* the parasitic stage lasts only for *six to eight days*. In one of my experiments the fish were infected on 11-12-'39, at about 7 p.m. and the first batch of free-living, young mussels were obtained on 17-12-'39, at about 3 p.m. By 19-12-'39, all the 'encysted' glochidia metamorphosed. Another batch of fish were infected on 12-1-'40, at about 4 p.m., and the first batch of metamorphosed stages were obtained on 18-1-'40 at about 5 p.m. This striking abbreviation of the period of parasitism is evidently related to tropical conditions of life. In a future account on the life-history of *Lamellidens* I hope to discuss, among other things, the significance of this feature, and its effect on the organogeny during the post-embryonic development.

R. V. SESHAIYA.

Annamalainagar,
January 17, 1940.

[1] Korschelt, *Vergleichende Entwicklungsgeschichte der Tiere*, 1936.

Palæolithic Sites in the Nellore District

DURING our residence at Nellore from 1935 to 1939 my wife and I, sometimes accompanied by two daughters, made a systematic examination of the area within easy walking distance of our house. This is the mission property on the trunk road to Madras near mile-stone 106. It lies upon the low ridge of laterite which for many miles roughly parallels the coast. We found evidences of iron age urn burials exposed in pits from which road metal is being removed. But from the surface of the ground in our own compound and the adjacent areas numerous palæolithic implements were gathered. A good many more were found on the bottom of old gravel pits while a number of interesting specimens were found *in situ* in the sides of pits dug in the laterite.

The most prolific area, however, was found just west of the laterite formation in a broad valley where bed rock of quartz and feldspar formation is thinly covered by a clay and gravel layer over which lies the sandy surface soil. In this valley we have gathered and listed many hundreds of interesting specimens. These were found most abundantly where a shallow stream bed and its branches have broken the surface of the plain bringing to light the gravel which is elsewhere buried.

This site was a centre of manufacture. A great quantity of chips, flakes, cores, and unfinished or spoiled tools are found. The raw material used by the ancient artisans was quartzite in the form of waterworn pebbles. Quartz was also used less frequently, some excellent implements having been made of this material. It is of interest that the specimens found seem to cover the whole range of palæolithic development from the crudest forms to the most skilfully made implements. The source of implements is twofold and may yield an explanation of this confusion.

One source to which implements are to be traced is the gravel layer mentioned above which is covered by surface soil, as indicated in the stream bank, to a depth of some two feet. We found a number of specimens *in situ* in this layer. These specimens show only slight patination. The second source from which specimens were gathered is the surface of the ground away from the areas broken by the stream and its tributary gullies. Certain generalizations may be made as to the specimens from these two sources. On the surface of the ground were found a few finely made specimens of the highest type of palæolithic craftsmanship represented in the entire collection. These included a fine handaxe and an equally interesting broad bladed cleaver. No implements of crude workmanship were found on the surface. A number of chips or flakes were found. All of these surface specimens have a uniform deep brown stain darker in tone on one side than the other. They also show a superficial disintegration, but no evidence of rolling. It may be assumed that they have lain a long time exposed to sun and weather.

The specimens found *in situ* in the gravel layer show but little of lateritisation or disintegration, having on the contrary a fresher appearance. These comparatively fresh looking specimens are, however, of cruder types. Within the area eroded by the stream the types are mixed as might be expected. But consistent with the above observation the best made implements show the darkest stain. It may be surmised that those having the dark stain came from the surface of the plain and the fresher looking ones from the gravel layer. It does not seem unreasonable to suppose the latter to be older but better protected, hence less deeply stained. The former being made last, became less deeply buried, if buried at all, and have been long exposed by the general erosion of the plain. The older, more deeply buried implements have been exposed only by recent stream action.

We have gathered specimens from 51 other sites in the Nellore District located along the trunk road from Madras and the road from Nellore westwards to Kalavaya, south of the Pennar River. This whole collection, superficially surveyed, compares in a general way with the group of implements found near

Nellore. Four sites near Udayagiri, sixty miles northwest of Nellore, yielded a distinctly different sort of implements. These are definitely more primitive in workmanship and are more weathered. Further study may confirm the theory that a cultural migration eastward can be traced, possibly following a retreating coastline.

At our invitation the collection has been inspected by Dr. F. H. Gravely, Superintendent of the Government Museum, Madras, and by Dr. A. Aiyappan, Curator of Ethnology. They have also gone with us to some of the sites. All specimens have been marked and listed. At the time of writing this preliminary report Dr. Aiyappan is preparing a complete catalogue using our lists and memoranda as to sites.

FRANK P. MANLEY.

Baptist Mission, Ramapatnam,
Nellore District,
February 3, 1940.

The Constitution of Rottlerin

A REDETERMINATION of the rotatory power of rottlerin methyl ether in this Laboratory has not supported the result[1] reported previously. The sample now examined showed no rotation in chloroform solution.

We have extracted Kamala with ether in the cold and the solution on chromatographic adsorption on alumina gave a zone amongst others from which *iso*rottlerin has been isolated. Therefore, there is no justification for the contention of Robertson *et al*[2] that *iso*rottlerin is formed during extraction of rottlerin by the action of hot toluene. Its presence in the natural product falsifies such a view.

J. N. RAY.

University Chemical Laboratories,
Lahore,
January 28, 1940.

1 Ray, Narang and Roy, *Curr. Sci.*, 1939, 8, 558.
2 *J.C.S.*, 1939, 1582.

Ascu Wood Preservative and the Forest Research Institute, Dehra Dun

I HAVE read with great interest your editorial on "Ascu Wood Preservative" published in the latest number of your valuable journal. You have very rightly pointed out that "It is not merely the future of a particular process that is involved now; it is the future of a pioneer industry still in its nascent stage". As Travancore has been a pioneer in the scientific utilisation of timber especially for major engineering structures and as Travancore has five Ascu-treating plants in operation, I was specially interested in your editorial.

The Forest Research Institute, Dehra Dun, in *Forest Research and Indian Industry*, published under the authority of the Government of India stated that "It is scarcely necessary to emphasise that the invention of Ascu (wood preservative) has now made it possible for indigenous timbers to compete with steel, iron and concrete for structural purposes so that a new industry of considerable importance is coming into being. This will not only increase the revenue of the Forest Department from sources which gave a poor income before, but will lead to the employment, directly and indirectly, of thousands of educated men, artisans and manual workers and will reduce imports of foreign materials".

I understand, it was on the recommendation of the Forest Research Institute, Dehra Dun, that all the Electrical Inspectors to Provincial Governments removed the ban on the use of wood poles for overhead electrical transmission and distribution provided the poles were treated with Ascu or any other approved wood preservative. It was on the advice of the Forest Research Institute, Dehra Dun, that the Governments of the U.P., Punjab, Mysore, Madras and Travancore either installed or called for tenders for wood poles "treated with Ascu or any other approved wood preservative" to the tune of 30,000 poles involving the investment of many lakhs of rupees. All the above Governments did not surely do this for the sake of experiment, and will have little confidence in

future in the Forest Research Institute. Further, in the note issued by Mr. L. Mason, President of the Forest Research Institute, to which reference was made in your last month's sub-editorial on "Ascu" wood preservative, it was stated that "No adverse reports have yet been received with regard to Ascu-treated timber used for general construction work or fence posts, nor any adverse reports came to hand regarding Ascu-treated electric transmission poles installed a few years ago in Mysore State". From a perusal of the appendices of the *Ascu Forest Record,* which has now been withdrawn, it would appear that the Forest Research Institute sent 3 ft. long fence posts to all electrical inspectors in India for testing in order to judge the efficacy of Ascu for the treatment of electrical poles. If no adverse reports have been received on fence posts treated with Ascu after 7 years experience with Ascu, and all that the Forest Research Institute has found is that poles with very shallow penetration and insufficient amount of Ascu have failed, it is not at all clear why the Forest Research Institute has taken the very drastic and unprecedented step of withdrawing what is avowedly an interim report. Without stating a single fact in the note issued by the Forest Research Institute relating to failure of any properly Ascu-treated timber pole or fence post, the action taken and the recommendation made by the Forest Research Institute is most bewildering. Any industrial or chemical process if faultily applied cannot give satisfactory results and Ascu process is no exception. To say that "new factors have been brought to light" by the failure within a year and a half or two years of poles which have been faultily treated is very unconvincing because if there is no Ascu penetration, no new factors of a mysterious character which could not be foreseen during the first 5½ years of the existence of Ascu can be brought into relief. The most obvious reason for the failure of these poles is because they received only superficial treatment with Ascu. It is strange why no reference has been made by the Forest Research Institute to the excellent condition of Ascu-treated poles treated under low pressure. The note, as drafted, is most misleading.

In a report on Ascu-treated wood for engineering construction printed and published by the Government of the United Provinces, it has been stated that "The Forest Research Institute, Dehra Dun, feels, therefore, justified in recommending Ascu to all Provincial Governments and non-official inquirers and has stated that Ascu appears to be, so far, the most efficient and economical wood preservative known". I feel, very serious issues of considerable public and scientific interest have arisen as a result of the publication of a note casting grave doubts on the efficacy of Ascu by the Forest Research Institute in which they announce the withdrawal for the first time in the history of the Institute, a research publication. The situation created by the action of the Forest Research Institute becomes all the more bewildering, as for the very purpose for which Ascu has been condemned for general use by the Forest Research Institute after Ascu had been in existence for 7 years, the largest pole using concern in the world, the American Telephone & Telegraph Co. of U.S.A. (which purchases annually 9 lakhs of treated wooden poles and which has the world-famous research organisation, Bell Telephone Laboratories, functioning under it) has recently purchased the patent rights for Ascu in the U.S.A. and Canada for a lakh of rupees for treating only electrical poles. As far as India is concerned, pole users are now in a dilemma as creosote has been already condemned to be unreliable and there is no wood preservative that the Forest Research Institute is prepared to recommend for general use. Imported steel poles are the only alternative. The unprecedented withdrawal of the *Ascu Forest Record* and the Institute's going back on their recommendation of Ascu based on failure of palpably improperly treated poles cannot enhance the confidence of the public in the Institute.

S. K. Pillai.

Office of the Director of Development,
Trivandrum,
February 14, 1940.

REVIEWS

Uses and Applications of Chemicals and Related Compounds. *A guide to the current industrial uses, potential applications and sales possibilities of 5,167 products.* Compiled and edited by T. C. Gregory. (Chapman & Hall, Ltd., London; Reinhold Publishing Corporation, New York), 1939. Pp. 665. Price $10·00.

A bewildering variety of chemical products, both synthetic and natural, are now produced in commercial quantities and employed in various arts and industries. The immense and rapid developments in the latter, through extensive fundamental and applied researches, have involved quite frequently the use of even common chemicals in new and unexpected directions. Sales executives, research directors, manufacturers, dealers and others, are naturally interested in these present-day uses of the several chemical products, each from their respective points of view, rendered readily accessible, but which they could hitherto find scattered in the published literature, not always easily available. To meet this demand, since 1922, there have been appearing in the pages of *Oil, Paint and Drug Reporter* a series of surveys covering the uses, potential applications and sales possibilities of chemicals and related products. In the present book is made available all this subject-matter after proper rearrangement, amplification and editing. The choice of items has been mainly based on their commercial importance, and they are arranged in alphabetical order according to their common names rather than according to their strict chemical names. However, the various synonyms and foreign names are given for each item. The applications are classified into appropriate subheadings, *e.g.*, for antimony pentoxide, the uses are grouped under ceramics, chemical, glass, metallurgical, paints and varnish, pharmaceutical, rubber and textile dyeing and printing.

The book is undoubtedly a compendium of useful information. M. A. G. RAU.

Astronomy. By R. H. Baker. (Macmillan & Co., Ltd., London), 1938. Third Edition. Pp. 517. Price 16/- net.

The volume before us is the second printing of the third edition of the well-known book on Astronomy by Prof. Baker, of Illinois University. It is easily the most comprehensive elementary textbook on Astronomy designed for use by college students, and would serve as an admirable introduction to more advanced treatises on the subject. Nearly half the book is devoted to the solar system, and the other half to stellar astronomy. The book has been brought absolutely up to date inasmuch as all recent advances on Astronomy which are capable of being presented in an elementary treatment have been incorporated. As examples we might mention the binary hypothesis of the origin of the solar system (p. 261), Baade's summary of supernovæ (p. 488), rotations of the stars (p. 386), reflection nebulæ (p. 448) and the problem of interstellar absorption (p. 465), clusters of external systems (p. 497). One will also notice rearrangement in the matter in several chapters, specially in the account of the galactic system. In discussing the source of stellar energy the author mentions the theory of Atkinson that the source is to be found in atom-building in the interior of stars, and the statement that this theory represents the prevailing view seems to be almost prophetic in view of Bethe's recent confirmation of these ideas.

If one is to find any fault with the book at all, it must be its very comprehensive nature which makes it rather unwieldy for use as a text-book by students. As a consequence of the size of the book, one finds, in a number of places, that explanations are not as full as might be desired, and many statements appear somewhat dogmatic.

As a book of reference, however, the book is most admirable, and is a veritable mine of information. For workers in other fields who want to get acquainted with the recent developments of Astronomy without wading through the technical journals one can hardly find a more suitable book. The only other book in the English language to which this work may have to give pride of place is perhaps the famous Russel-Dugan-Stewart, and that is sufficiently high praise.

B. S. MADHAVA RAO.

Text-Book of Comparative Physiology. By Charles Gardner Rogers. Second Edition. (McGraw Hill Publishing Co., Ltd., London), 1938. Pp. xviii + 715. Price 30*sh*.

The early development of biological sciences is characterised by the accumulation of a vast amount of purely descriptive and morphological data and in the early stages, the progress of physiology was dominated and determined by the needs of medical science. During the last two decades, however, increasing attention is being focussed on the vital processes which accompany various forms of living matter. Among the diverse forms of organic life, one can perceive an underlying unity of animal function when the fundamental reactions of life, like digestion, assimilation, respiration, excretion, response to stimuli, reproduction, etc., are viewed as unit processes characteristic of animals. The purpose of comparative physiology is to study these activities in relation to the varying morphological structure of organs and determine their functional significance in the evolutionary development of the animal. There is a vast amount of information on the physiology of various classes of animals; these facts have to be presented in a new perspective with a view to understand the functional unity which manifests itself among the entire and diverse range of animal life. This is a difficult task, which has been ably accomplished by the author.

The eighteen chapters comprising the volume, cover the entire field of comparative physiology and constitute an admirable introduction to the subject. The volume represents the outgrowth of a course in comparative physiology, which has for a number of years been offered to students in Oberlin College. This is a volume which is bound to interest a large circle of students and investigators. M. S.

The Newer Knowledge of Nutrition. By E. V. McCollum, Elsa Orent-Keiles and Harry G. Day. Fifth Edition. (Macmillan Co., London), 1939. Pp. viii + 701. Price 18*sh*.

This is the fifth edition of a well-known and comprehensive volume on nutrition written by Professor McCollum who is one of the foremost investigators in this important and practical branch of scientific knowledge. During the last few years spectacular advances have been made in this rapidly advancing field of nutrition; the chemical nature of the more important vitamins has been unravelled; while some of them have been synthesised. The mechanism of their action, their mode of preventing the deficiency diseases and their physiological role in the maintenance of the normal vital functions of the organism, are all being gradually revealed.

The public is becoming more and more food-conscious; there has been an insistent demand for authoritative and accurate information regarding nutrition. The more advanced nations of the world, have recognised that provision of a well-balanced and scientifically planned nutrition, constitutes the best form of insurance against disease and inefficiency. Advances in our knowledge of nutrition have brought the principles of preventive medicine to the forefront and the curative aspects of medical assistance, however spectacular they may be at the moment, is bound to suffer a gradual set-back in course of time.

Professor McCollum's volume provides a concise, scientifically accurate and authoritative survey of the field of nutrition and should be widely read by all those who are seeking to determine what is sound and what is speculation or misinformation in respect to the nutritive needs of several species including man. The dietary properties of foodstuffs, the characterisation of malnutrition due to specific or to multiple deficiency states, the occurrence of various types of malnutrition in man and animal in different parts of the world and the means of effectively combating these problems of nutrition, these are the subjects dealt with in the volume which should interest not only the routine medical practitioner and the public health specialist, but also the administrator who is entrusted with the responsible task of maintaining national fitness and efficiency.

M. S.

A Text-Book of Geology.—Part I. *Physical Geology*. By Profs. Chester R. Longwell, Adolph Knopf and Richard R. Flint. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1939. Pp. xi + 543. Price 18*sh*. 6*d*. net.

This book is the second, revised, edition of the one which had been published by the same authors in 1932. In this edition, while maintaining the general plan of treatment

REVIEWS

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Astronomy. By R. H. Baker. (Macmillan & Co., Ltd., London), 1938. Third Edition. Pp. 517. Price 16/- net.

The volume before us is the second printing of the third edition of the well-known book on Astronomy by Prof. Baker, of Illinois University. It is easily the most comprehensive elementary textbook on Astronomy designed for use by college students, and would serve as an admirable introduction to more advanced treatises on the subject. Nearly half the book is devoted to the solar system, and the other half to stellar astronomy. The book has been brought absolutely up to date inasmuch as all recent advances on Astronomy which are capable of being presented in an elementary treatment have been incorporated. As examples we might mention the binary hypothesis of the origin of the solar system (p. 261), Baade's summary of supernovæ (p. 488), rotations of the stars (p. 386), reflection nebulæ (p. 448) and the problem of interstellar absorption (p. 465), clusters of external systems (p. 497). One will also notice rearrangement in the matter in several chapters, specially in the account of the galactic system. In discussing the source of stellar energy the author mentions the theory of Atkinson that the source is to be found in atom-building in the interior of stars, and the statement that this theory represents the prevailing view seems to be almost prophetic in view of Bethe's recent confirmation of these ideas.

If one is to find any fault with the book at all, it must be its very comprehensive nature which makes it rather unwieldy for use as a text-book by students. As a consequence of the size of the book, one finds, in a number of places, that explanations are not as full as might be desired, and many statements appear somewhat dogmatic.

As a book of reference, however, the book is most admirable, and is a veritable mine of information. For workers in other fields who want to get acquainted with the recent developments of Astronomy without wading through the technical journals one can hardly find a more suitable book. The only other book in the English language to which this work may have to give pride of place is perhaps the famous Russel-Dugan-Stewart, and that is sufficiently high praise.

B. S. Madhava Rao.

Text-Book of Comparative Physiology. By Charles Gardner Rogers. Second Edition. (McGraw Hill Publishing Co., Ltd., London), 1938. Pp. xviii + 715. Price 30*sh.*

The early development of biological sciences is characterised by the accumulation of a vast amount of purely descriptive and morphological data and in the early stages, the progress of physiology was dominated and determined by the needs of medical science. During the last two decades, however, increasing attention is being focussed on the vital processes which accompany various forms of living matter. Among the diverse forms of organic life, one can perceive an underlying unity of animal function when the fundamental reactions of life, like digestion, assimilation, respiration, excretion, response to stimuli, reproduction, etc., are viewed as unit processes characteristic of animals. The purpose of comparative physiology is to study these activities in relation to the varying morphological structure of organs and determine their functional significance in the evolutionary development of the animal. There is a vast amount of information on the physiology of various classes of animals; these facts have to be presented in a new perspective with a view to understand the functional unity which manifests itself among the entire and diverse range of animal life. This is a difficult task, which has been ably accomplished by the author.

The eighteen chapters comprising the volume, cover the entire field of comparative physiology and constitute an admirable introduction to the subject. The volume represents the outgrowth of a course in comparative physiology, which has for a number of years been offered to students in Oberlin College. This is a volume which is bound to interest a large circle of students and investigators. M. S.

The Newer Knowledge of Nutrition. By E. V. McCollum, Elsa Orent-Keiles and Harry G. Day. Fifth Edition. (Macmillan Co., London), 1939. Pp. viii + 701. Price 18*sh.*

This is the fifth edition of a well-known and comprehensive volume on nutrition written by Professor McCollum who is one of the foremost investigators in this important and practical branch of scientific knowledge. During the last few years spectacular advances have been made in this rapidly advancing field of nutrition; the chemical nature of the more important vitamins has been unravelled; while some of them have been synthesised. The mechanism of their action, their mode of preventing the deficiency diseases and their physiological role in the maintenance of the normal vital functions of the organism, are all being gradually revealed.

The public is becoming more and more food-conscious; there has been an insistent demand for authoritative and accurate information regarding nutrition. The more advanced nations of the world, have recognised that provision of a well-balanced and scientifically planned nutrition, constitutes the best form of insurance against disease and inefficiency. Advances in our knowledge of nutrition have brought the principles of preventive medicine to the forefront and the curative aspects of medical assistance, however spectacular they may be at the moment, is bound to suffer a gradual set-back in course of time.

Professor McCollum's volume provides a concise, scientifically accurate and authoritative survey of the field of nutrition and should be widely read by all those who are seeking to determine what is sound and what is speculation or misinformation in respect to the nutritive needs of several species including man. The dietary properties of foodstuffs, the characterisation of malnutrition due to specific or to multiple deficiency states, the occurrence of various types of malnutrition in man and animal in different parts of the world and the means of effectively combating these problems of nutrition, these are the subjects dealt with in the volume which should interest not only the routine medical practitioner and the public health specialist, but also the administrator who is entrusted with the responsible task of maintaining national fitness and efficiency.

M. S.

A Text-Book of Geology.—Part I. *Physical Geology.* By Profs. Chester R. Longwell, Adolph Knopf and Richard R. Flint. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1939. Pp. xi + 543. Price 18*sh.* 6*d.* net.

This book is the second, revised, edition of the one which had been published by the same authors in 1932. In this edition, while maintaining the general plan of treatment

of the original edition, the authors have added two new chapters,—one dealing with mass-wasting at the earth's surface and the other describing, specially, the sculpturing of lands by streams under different climatic conditions. All the chapters have been thoroughly revised and several have been completely rearranged and rewritten.

The present edition consists of 20 chapters and 4 appendices. The first chapter gives some introductory account of the earth as a member of the Solar System; its origin, shape, size, form and major divisions; the nature of rock mantle composing its crust; and the several branches into which geology—the science of the earth—could be subdivided. The next nine chapters deal with the processes of rock weathering and mass movements of rock waste leading to landslides, soil creeps and similar other features; and the action of running water, sub-surface water, lakes, glaciers, wind and sea as agents of erosion and deposition. Chapter 11 describes the sedimentary rocks; and the next one, Chapter 12, gives particulars about igneous rocks. Chapter 13 describes volcanoes and volcanic action. In Chapter 14, entitled "Deformation of the Earth's Crust", are described various kinds of movements of the earth's crust and their effects on the rock formations resulting in the warping of the strata, folding, faults, and joints, etc. Chapter 15 describes the causes and effects of earthquakes, seismic belts, seismographs and other particulars relating to that subject. In the next chapter a detailed account is given of the various types of metamorphism and how they are brought about, including a brief note on the retrograde metamorphism. Chapters 17 and 18 deal with the theoretical aspects such as the conditions of the earth's interior, isostacy, mode of origin of mountain ranges and the causes for crustal movements. In Chapter 19, the genesis of various land forms are described dealing mostly with the forms produced by river erosion. This seems to be a supplement to what has already been described in Chapter 5, under sculpture of lands by streams. The next and final chapter of the text gives an account of the mineral resources describing the mode of origin of coal, oil and gas formations and also the mode of origin of the important ore deposits of metals and non-metals.

Descriptions of important rock-forming minerals and rock types are given in the first two appendices; and in the third one, a brief account of the topographic maps and their construction and uses. The time-scale of the earth history forms the last appendix and completes the book.

From this brief review of the sequence of contents of the book it is seen that the plan of treatment adopted by the authors is somewhat different from what is generally found in other, older, well-known text-books on geology. Terms like Foliates, Solifluction, Mass-wasting, etc., which have not yet come into general usage, at least on this side, are likely to sound strange and unfamiliar; but they have all been clearly explained. Practical aspects of some of the geological processes have also been briefly dealt with in appropriate places. Cases, illustrative of geological processes, have been drawn largely from American occurrences.

To each chapter is added a list of "Reading References"; but many of these, dealing specially with American areas, are not of general interest and, moreover, some of the references given, are not likely to be readily available to college students in India.

The book, however, has been well written, in an easy and attractive style, and profusely illustrated with well-chosen photographs. It contains much useful and new information and will form a fitting addition to the several text-books existing on the subject.

B. RAMA RAO.

Geology and Allied Sciences. By Walther Huebner. Part I. *German-English.* (Veritas Press, New York), 1939. Price $7·50.

We have great pleasure in welcoming this book which, as the sub-title indicates, is a "Thesaurus and a co-ordination of English and German specific and general terms" relating to Geology and allied sciences. The book contains more than 25,000 entries, and the value of the work has been greatly enhanced by the fact that related terms have been grouped under one key-word, thus facilitating a general survey of related geological terms. The author has obviously devoted a considerable amount of time and attention in compiling this Thesaurus, and we must say that the result has been thoroughly satisfactory. We can assure the author that the value and usefulness of the book will be widely appreciated.

The book has been published by Veritas Press, Inc., of New York, and its general get-up is excellent.

L. RAMA RAO.

Tables of Partitions. By Hansraj Gupta. (Published by the Indian Mathematical Society, Presidency College, Madras). Pp. 81. Price Rs. 5.

The Indian Mathematical Society and the Punjab University deserve the congratulations of the mathematical world by sponsoring the publication of this Table worked out with commendable zeal by Dr. Gupta. It is quite appropriate that this work was undertaken in our country as the late Ramanujan was one of the most brilliant workers in the theory of partitions. One can recall the startling conjectures of Ramanujan, made in the second decade of this century, some of which were proved after a long time; (some were wrong) it was a wonder how Ramanujan was able to give the results. This Table contains the unrestricted partitions of all numbers up to 600 and the partitions with the smallest part equal to any integer less than 50. The book is valuable for workers in the field and must be available in every college library. K. V.

Three-Figure Mathematical Tables and Physical Constants. By V. C. Varghese. Price 4 annas.

This booklet contains logarithmic, trigonometric and square and cube tables. At the end the values of a few physical constants also are given. It also contains an explanatory chapter of five pages. The book is well printed and is recommended for the use of beginners in logarithmic computation. It would have been better if the author had been more careful in the explanations and had avoided ambiguous statements. For example, instead of "Logarithm is a *continuous* function of numbers. Hence we can infer within what integral limits the logarithm .... lie" (p. 16), it would have been better if he had put *increasing* instead of *continuous*. The statement "the logarithm of any number has two parts" (p. 16), is not a happy expression. K. V.

Intermediate Chemistry. By T. M. Lowry and A. C. Cavell. (MacMillan & Co., London), 1939. Pp. 876. Price 12*sh*. 6*d*.

This is a comprehensive text-book of Chemistry embracing all the three branches, Inorganic, Physical and Organic. It is divided into six parts and contains sixty-one chapters. The first part dealing with General and Theoretical Chemistry includes the modern concepts regarding the structure of Matter and the Electronic Theory of Valency. The second part deals with the Chemistry of typical elements, while the transitional elements are treated separately in the third part. The fourth part deals both with qualitative and quantitative analysis and those portions dealing with volumetric gravimetric and organic analysis will be particularly useful for all students who are to take a practical examination in Chemistry. The last two chapters deal with the principles of Physical Chemistry and the fundamentals of Organic Chemistry. Not the least useful part of the book is a set of questions appended at the end, which are chosen from a number of University papers. The treatment of the several branches is quite good, and lucid. This book will be of great use for not only the Intermediate students but also for students taking up the B.Sc. (Pass) Degree course of most of the Indian Universities. M. SESHAIYENGAR.

Sammlung Göschen des Wissen der Welt, XV. Pflanzenzuchtung. By Dr. Hermann Kuckuck. (Walter de Grunter & Co., Berlin), 1939. Pp. 125. Price RM. 1·62.

This little book is one of the series named "Sammlung Göschen", which aims to give a clear and easily understandable introduction to all the branches of science and its technical applications.

The volume before us deals with the subject of plant improvement. The first chapter gives a concise account of Mendelism. The second, which forms the chief body of the book, deals with the selection of the following types of plants: (1) those reproducing vegetatively, (2) those depending on self-pollination, (3) those depending on cross-pollination. Then there are chapters on Genetics and the relation between Pathology and Physiology on the one hand, and plant improvement on the other.

The outlook is refreshingly modern and the author has presented, in simple language, a considerable amount of information within a very short space. P. M.

Coal Utilisation. *University of Illinois Bulletin*, Engineering Experiment Station Circular Series No. 39. (*Bulletin* 7 of Vol. 37, being Papers presented at the Fifth Short Course in Coal Utilisation), May 1939.

The Illinois University is noted for the valuable contributions on the subject of coal, that appear from time to time from its laboratories. This *Bulletin* is in a category by itself a curious mixture—and in spite

of some good material to be found in it, one cannot say that it is on the whole worthy of the *imprimatur* of the University; with judicious pruning and editing it might have been.

A number of the papers deal with various aspects of *mechanical stokers* in domestic heating units in the United States and apart from the fact that they show the important part that central heating plays in the life of the average American citizen, they have probably little interest for the Indian reader. They indicate, however, that fuel utilisation engineers in the States are taking an intelligent interest in fuel combustion problems. Two papers on *Coal Sizing* show the complexity of this important aspect of coal preparation and marketing and indicate that there is, in America, as much need for simplification of the system of grading and sizing of coals as there has been, and still is, in India. We learn, for example, from Joseph Harrington, that there have till recently been at least twenty-four different sizes of coals marketed, and no doubt his list is not exhaustive. A very useful, admirably concise paper on *Coal Sampling,* by H. F. Hebley, deserves special mention, and might well be read by both buyers and sellers of coal in this country. It is accompanied by two useful tables, one on the procedure for gross sampling and the other, on the subsequent reduction of the gross sample for laboratory purposes. The accompanying suggestions or hints are excellent.

It is interesting to note that the recently devised *Crucible Swelling Test* of the British Standards Institution has proved of practical value to one of the authors—R. A. Sherman, in his admirable paper on the Evaluation of Coal for use in Domestic Stokers—a paper that might suggest a similar piece of work on the testing of coals in India for various purposes. In this paper, incidentally, there is special mention of the practical application of oil for mitigating the dust nuisance. Work has been done in the past two or three years on this problem in Britain and the reviewer can testify to the almost amazing effect of the introduction into a dusty coal of a mere trace of a suitable oil. Sherman recommends careful sizing before oil treatment, especially removing fines.

Many of the papers are hardly worthy of printing. There are, no doubt, difficulties in the way of a ruthless editing of papers of the kind likely to be presented at a conference of this sort and these probably account for the two or three puerile efforts that have been included—efforts more suggestive of Main Street and the Boosters' Club than of serious contributions to the solution of the problems of the Coal Industry. In the opinion of the reviewer, these papers ought to have been summarised by a capable fuel-technologist, and the essentials—at least of the discursive "after-dinner" types included—presented in the form of a consolidated report for the information of fuel technologists, suppliers and consumers.

CHARLES FORRESTER.

Wireless. By C. L. Boltz. (The Scientific Book Club, London), 1939. Pp. 278. Price for members 2*sh.* 6*d.*

"Listening in" through the "radio" or "wireless" set has now become an almost universal practice. Many of the modern listeners are, however, interested beyond the few knobs that 'let in' the music or other broadcast programmes from distant parts of the world. The Scientific Book Club has, therefore, rendered a distinct and timely service in bringing out this very well written book and placing it within the reach of all.

The author has explained clearly and in simple language the important foundations upon which are reared the puzzling mysteries and wonders of radio as we know it to-day. All the fundamental principles have been treated with the aid of the most elementary arithmetic and mathematics. Indeed the more enthusiastic reader who has gone through this book carefully will be in a position to read the appropriate periodicals and keep himself up to date. Attention is drawn to the important factors in a receiver such as sensitivity, selectivity, band-pass tuning and detection. The general characteristics of the different types of valves—diode, triode, tetrode, pentode, etc.,—are briefly described, and are followed by a somewhat detailed discussion on low and high frequency amplification. Separate chapters deal with the straight set, the Superhet, Shortwaves and the mains and other types of receivers. The last two chapters on the gramophone and television will be found to be a welcome addition to the usual range of topics.

Bold-type printing and a good get-up are advantages which will weigh with the class of reader for whom the book is meant and with whom we feel sure, the book will prove popular.

C. R. K.

GENERAL CIRCULATION OF THE ATMOSPHERE OVER INDIA AND ITS NEIGHBOURHOOD

TO the present-day meteorologist weather is but an outcome of the interactions of different air masses. The air masses cannot be recognised on the weather maps unless these furnish three-dimensional picture of what is happening. The forecaster is thus vitally concerned with the detailed wind data from day to day at all levels and, at the same time, ought to be thoroughly familiar with the normal patterns of wind movement at all times of the year and all altitudes. A recent memoir by Ramanathan and Ramakrishnan (*Memoirs of the India Meteorological Department*, 1939, 26, Part 10) giving encyclopædic information of winds in the upper atmosphere over an area extending roughly from Comorin to Kashmir and from Bahrein to Rangoon, makes a detailed and most useful survey of the general circulation of the atmosphere over that region, and is therefore welcome to all students of meteorology and particularly to the forecasters in India itself. On going through the volume one is greatly impressed with the stupendous amount of work involved in collating the large mass of data, the thorough treatment of the subject under study, and the care and thought bestowed in the preparation of the charts.

Six plates are given for each month showing the charts of monthly mean streamlines prepared from pilot balloon data for the levels 1 to 4, 6 and 8 km., and on these are also shown the upper air isotherms as derived from the variation of pilot balloon winds with height. In addition, some of the plates include, as separate insets, charts showing the directions of cloud movement and wind roses at a few selected stations. The main characteristics of upper wind and temperature distribution from month to month as revealed by these charts and their association with the general trend of weather in different seasons, regions of development and progress of cyclonic storms and some of the more important local weather phenomena, such as, nor'westers in Bengal are discussed briefly in the text. A summary of the salient features of the general circulation of the atmosphere is then given, and a brief comparison is made of the upper air conditions in this region with those in corresponding latitudes in some other parts of the northern hemisphere.

A regular northward and southward movement of the upper wind system is noticed, the movement being mainly meridional in the winter half of the year, and from the southwest Bay of Bengal to northwest India and back in the summer half. Again, an examination of the monthly streamline charts for the winter and hot seasons shows that, on the mean, and especially during settled weather, the westerly winds of higher latitudes, as they travel southwards, tend to become northerly and then north-easterly and eventually get merged in the easterly circulation of lower latitudes. A reverse process takes place during periods of disturbed weather with clouds and rain, when the easterly winds from the southern latitudes slowly turn towards the north and northeast and on reaching North India feed the westerly circulation prevailing over that region. The above in effect means that while, during fine weather, the greater part of the country is overrun by dry air of land origin, moister air from lower latitudes travelling across the Bay of Bengal penetrates farther northwards than usually during spells of unsettled weather. This is an important feature of the wind movement over India and is to be borne in mind carefully while analysing the weather charts relating to the central parts of the country and the north Deccan—the regions lying in the zone of transition from westerly to easterly winds. A further point of interest which has also been noticed elsewhere is brought out by the diagrams on Plate II. These show that, in the winter and hot seasons, winds with westerly components prevail farther southward in the higher levels, and that the greater the speed of the westerlies at the latitude of about 25° N., the further is the southward extension. The influence of the high mountain ranges to the north on the upper air circulation over the northern half of the country upto a height of about 6 km. is mentioned, and the localisation of the monsoon low to within the confines of India is also explained as being due to the same cause.

As mentioned above, the memoir is a valuable contribution to Indian Meteorology, and besides being of value to meteorologists, it is of great help and interest to aviators because of the important series of 74 charts which form the major bulk of the volume.

A. K. ROY.

CENTENARIES

Whitworth, William Allen (1840–1905)

WILLIAM ALLEN WHITWORTH, a British mathematician, was born at Runcorn, February 1, 1840. He had his education at Sandicroft School, Norwich, and St. John's College, Cambridge, became an M.A. in 1865 and was a Fellow of his college from 1867 to 1882, after teaching in schools and acting as professor at Queen's College, Liverpool, for some time. He had also a high reputation as a priest and religious writer.

Messenger of Mathematics

Even as a boy he showed unusual mathematical propensities and while still an undergraduate he became joint-editor of the *Oxford, Cambridge and Dublin messenger of mathematics* which began its career in 1861. He continued to be one of its editors for twenty years.

Choice and Chance

His first article entitled "The equiangular spiral, its chief properties proved geometrically" had the honour of being translated into French. His first book was *Trilinear co-ordinates and other methods of modern analytical geometry of two dimensions* (1866). This was followed by his best known work, which still continues to be a favourite with students of mathematics, *viz.*, *Choice and chance, an elementary treatise on permutations, combinations and probability* (1867). It was based on lectures delivered at Queen's College, Liverpool, and is a model of clear mathematical exposition. It has gone through several editions.

Other Activities

Whitworth was a great success as a preacher and he was Hulsean lecturer at Cambridge during 1903–04 and was made a prebendary of St. Paul's Cathedral in 1900. There are many ecclesiastical works to his credit and one of them is a bridge between that group of his writings and his mathematical ones, *viz.*, *The churchman's almanac for eight centuries* (1882). It is a mathematical calculation of the date of every Sunday.

After a serious operation at Fitzroy House Nursing Home, Whitworth died, March 12, 1905.

Dunlop, John Boyd (1840–1921)

JOHN BOYD DUNLOP, the inventor of the pneumatic rubber tyre, was born of a farmer at Dreghorn, Ayrshire, February 5, 1840. Being considered too delicate for farm work, he was sent to Edinburgh for higher studies. He specialised in veterinary science and settled at Belfast where he established what was one of the largest practices in Ireland.

His Son Jarred

One day in 1887, his son John, then nine years of age, complained of being jarred as he rode on his tricycle over the rough setts with which the street was paved. Dunlop's mind took up the problem. He made an air-tube, laid it round the periphery of a wooden dish and found it, by trial, to have greater resilience than the tricycle wheel. Then he fixed on the wheels of his son's tricycle rims of wood fitted with air-tubes and it proved a success. He took a patent on December 7, 1888, and put on the market machines complete with pneumatic tyres. A racing cycle built with such tyres brought them to prominence in 1889 and William Harvey Du Cross, the father of some defeated riders, made the acquaintance of Dunlop and entered into partnership with him and established the Pneumatic Tyre and Booth's Cycle Agency at Dublin.

Dunlop Rubber Company

The pneumatic tyre revolutionised cycling and made possible the modern motor. Dunlop himself did not profit greatly from the success of this invention. E. T. Hooley, an able financier, floated the Dunlop Rubber Company with a large capital and many subsidiary companies.

Dunlop himself lived quietly at Bells Bridge, Dublin. His daughter published some of his reminiscences as the *History of pneumatic tyre*, two years after his death which occurred October 23, 1921.

Maxim, Hiram Stevens (1840–1916)

SIR HIRAM STEVENS MAXIM, a British-American inventor, was born at Sangerville, Maine, U.S.A., February 5, 1840. His father's home was in the midst of a dense forest, infested by bears and this made Hiram's boyhood adventurous and his training one of sturdy self-reliance. He learned wood-turning from his father, and eagerly read any book that came within his reach. At the age of fourteen he was apprenticed to a carriage-builder who made him work sixteen hours a day, on four dollars a month, not paid in cash but largely taken in goods at the local store. After seeing some more similar hack work, eventually in 1864 Maxim joined one of his uncles who maintained engineering works where he learned some technical work and later entered the service of Oliver Drake, an instrument maker. From 1878 to 1881 he was chief engineer to the United States Electric Lighting Company—the first of its kind. Here he made some notable discoveries and in particular an electrical pressure regulator which, being shown at the Paris Exhibition (1881), earned for him the *Legion d'honour*.

Maxim Guns

Then he settled in London and soon afterwards constructed an automatic gun, which was inspected by the Prince of Wales and the Commander-in-Chief and was adopted, after some improvement, in the British Army (1889) and in the Royal Navy (1892). It fired at the rate of ten shots a second. The Maxim Gun Company was formed in 1884 to develop the patent.

Flying Machines

From 1889–1894 Maxim concentrated his thought on the construction of a steam-driven flying machine. He spent £20,000 on it. During a trial carried out in 1894, it did actually

lift itself from the ground and confirmed the inventor's assumption that "if a domestic goose can fly, so can a man". It would have been a greater success if he had invented an internal combustion engine.

A CHRONIC INVENTOR

Maxim's knowledge of physics and chemistry and his ingenuity in tool-making led to his improving every machine that he used. In all he took out 262 patents. His range of invention included an improved mouse-trap, automatic gas generators, automatic sprinkling apparatus for extinguishing fire, steam and vacuum pumps, engine governors, gas motors, maximite the predecessor of cordite as smokeless gunpowder, an inhaler for bronchites and a merry-go-round. His amazing versatility, ingenuity and skill justified his calling himself a "chronic inventor".

Maxim died at his home at Streatham after a short illness, November 24, 1916.

Holland, John Philip (1840–1914)

JOHN PHILIP HOLLAND, an Irish-American teacher and an inventor of submarine, was born in Liscanor, County Clare, Ireland, February 29, 1840. He was a teacher in Ireland from 1858 to 1872, when he migrated to U.S.A. and became a teacher again in Paterson, N.J.

MOTIVE

As an Irish patriot, he conceived the submarine boat in his youth as a potential weapon to be used against the British navy to secure Irish independence. He had studied the scanty literature on the subject. In 1875 the Fenian Society offered to finance his experiments. The first small craft was completed in 1878 but got buried in the river mud during the test. It was salvaged only in 1927 to be placed in the local museum. But the Fenians did not lose heart. They gave Holland another sum of $23,000 "to build a full-size submarine, which it was hoped, would cross the Atlantic and destroy the English fleet". The submarine was constructed. It was christened *Fenian Ram* and launched in the Hudson River in May 1881. It was 31 feet long, 6 feet beam and 19 tons displacement, with a crew of 3 men. It is kept as a memorial in a city park in Paterson.

FRUSTRATION BY OFFICIALDOM

In 1875, Holland offered his submarine design to the United States Navy; but it was rejected by the officials of the navy as a fantastic scheme of a civilian landsman. From 1888 onwards, Holland tendered at various times plans for a submarine to the American Navy. In 1895 he obtained a contract to build the *Plunger*; but it was thoroughly spoiled, during construction, by the self-willed chief of the naval Bureau of Steam Engineering who ignored his specifications.

RECOGNITION AT LAST

Holland began to construct another submarine incorporating all the ideas which he was prevented from using in the *Plunger*. It was christened *Holland* and launched in 1898. One of its novel features was its ability to dive to a desired depth. After a number a severe tests, it was purchased by the Navy in 1900. Then Holland received orders for six more submarines for the U.S.A., and for several others for Great Britain, Russia and Japan. He designed two submarines for Japan during the Russo-Japanese War, for which he received in 1910 the "Order of the Rising Sun". In 1904 he devised a respirator for escape from disabled submarines.

EXPLOITATION BY FINANCIERS

Though he thus realised the dream of his youth, he was not financially happy. The financiers of the J. P. Holland Torpedo Boat Co., proved to be such money-grubs that they wished to retire him as a figurehead at a salary of $10,000 per annum and they so managed the money market that Holland could not succeed in floating another independent company either.

Holland died at Newark, August 12, 1914.

S. R. RANGANATHAN.

ASTRONOMICAL NOTES

Planets during March 1940.—Mercury may be glimpsed for the first few days of the month near the western horizon immediately after sunset. It is rapidly getting nearer the Sun, reaching inferior conjunction on March 15. Venus is increasing in brightness (its magnitude will be $-3 \cdot 8$ at the end of the month) and will be a conspicuous object in the evening sky, setting nearly three hours after the Sun. On March 8, the planet will be in conjunction with Saturn. Mars is moving eastward in the constellation Aries and will become fainter, as the distance from the earth increases.

Jupiter is getting close to the sun and is not favourably placed for observation. Saturn likewise, will be approaching the Sun, but can still be seen as a first magnitude star in the western evening sky. The ring ellipse is gradually widening, the angular dimensions of the major and minor axes on March 15 being $37'' \cdot 3$ and $10'' \cdot 2$ respectively. Uranus continues to move slowly eastward in the constellation Aries and can be seen close to the fourth magnitude star δ Arietis. A conjunction with the Moon on March 14 will be helpful in locating the planet. Neptune is in opposition to the Sun on March 15; it will be about three degrees west of the star β Virginis and can be observed with a small telescope.

Among lunar occultations of some interest that will be visible in this country, may be mentioned that of δ Tauri (mag. $3 \cdot 9$) at about 7 p.m. on March 15 and that of λ Geminorum (mag. $3 \cdot 6$) a few minutes after midnight on March 19.

Ceres, the first of the minor planets discovered, will be in opposition on March 10. It will be of magnitude $7 \cdot 0$ at the time, and with a binocular, can be seen about two degrees away to the north-east of the third magnitude star δ Leonis.

T. P. B.

MAGNETIC NOTES

MAGNETIC STORMS AND DISTURBED DAYS AT ALIBAG 1938

THE Records of the Alibag Magnetic Observatory for 1938 show a larger activity than those of the year 1937. The activity during any year is determined by the character of days during that year. At Bombay, days are classified as *quiet* days, days of *slight* disturbance or of *large* disturbance corresponding to the international[1] characters 0, 1 and 2. Days of large disturbance are reclassified into those of *moderate, great* or *very great* disturbance on the basis of the oscillations in the magnetograms. During the year there were 132 quiet days, 185 days of slight disturbance and 48 of large disturbance as against 158, 167 and 40 during the previous year. In 1938, the days of large disturbances consisted of 4 days of very great, 8 of great and 36 of moderate disturbance as against 1, 9 and 30 during 1937. In 1938 January was the most disturbed and June the least disturbed month, corresponding to October and August in the preceding year. The monthly characters during 1938 are shown in Table I.

TABLE I

	Mean character figure	
	Bombay	International[2]
1938		
January ..	1·07	1·08
February ..	0·75	0·79
March	0·58	0·65
April	0·57	0·80
May	0·55	0·76
June	0·40	0·59
July	0·52	0·73
August ..	0·81	0·73
September ..	1·03	0 83
October ..	0·94	0·81
November ..	1·03	0·67
December ..	0·97	0·66

The mean character for 1938 is 0·77 according to Bombay classification and 0·76 according to the international classification done at De Bilt on the basis of data from 68 observatories of the world. The number of days of different characters in individual months is shown in Table II.

TABLE II

	Number of days (Bombay classification)		
	0 character	1 character	2 character
1938			
January ..	5	19	7
February ..	10	15	3
March ..	16	12	3
April ..	15	12	3
May ..	16	13	2
June ..	18	12	0
July ..	18	10	3
August ..	12	13	6
September ..	5	19	6
October ..	9	15	7
November ..	4	21	5
December ..	4	21	3
Total ..	132	185	48

Magnetic Storms.—During the year 1938 there were 4 storms of very great intensity the severest of them being the one of 16th April. This also happens to be the severest storm since 1922. This storm, though of a short duration, was rather violent, and the Indian Telegraph Department observed "foreign incoming currents of varying intensity" in several important circuits. Similar disturbance to telegraph traffic was also noticed by observers in southern Norway where "the earth-currents on the lines between 7^h 30^m and 9^h mid. Eur. Time, were so great that they could not be measured (the measurable maximum being 150 milliamperes) and all telegraphic transmission was impossible.

On the telephone lines the tension potential increased to about 1,000 volts"[3]. The magnetograms showed prominent "sudden commencements". H reached 37,956 gammas which is the highest recorded by the Alibag H magnetograph since its installation in 1904. The observers at Huancayo also report this as the most intense storm recorded by them since the establishment of their observatory in 1922.[4]

The storm next in intensity was that of January 22. The H-range in this case was 613 gammas and is the highest in the last ten years. H went off the recording limit and was brought within the field by means of a controlling magnet. The minimum in H was 37,219 gammas and is the lowest since the last five years. Two more storms of very great intensity were recorded on January 16 and January 25. In the former case, the sudden commencements were unusually large, that in H measuring 167 gammas. The latter storm was associated with a gorgeous aurora which was visible over a large part of the Globe.[5] There were eight storms of great intensity during the year. The times of commencement and cessation of the more important storms during the year are given in Table III. The number of moderate storms during the year was 21.

TABLE III

	G.M.T. of				Range in gammas	Intensity G=great V.G.=very great
	Beg.		End.			
	H.	M.	D.	H.		
1938						
Jan. 16	22	32	18	22·5	388	V.G.
,, 22	2	42	23	0	613	,,
,, 25	11	50	26	20	>477	,,
Feb. 8	10	38	10	14	196	G.
March 5	3	15	5	20	238	,,
,, 22	4	32	22	19·5	226	,,
April 16	5	45	16	23	532	V.G.
May 11	15	31	12	16	293	G.
July 15	3	14	16	20·5	256	,,
August 11	3	20	13	9	245	,,
Sept. 27	22	1	29	15·5	202	,,
Oct. 7	6	13	8	22	326	,,

M. R. RANGASWAMI.

Department of Terrestrial Magnetism,
The Observatory,
Bombay,
February 4, 1940.

[1] Method as recommended by the Int. Comm. of Terr. Mag. and Atm. Elec., in their Circular Letter of March 1924.

[2] From *Caractre Magnetique de l' annee*, 1938, Table II.

[3] C. Stormer, *Terr. Mag.*, 1939, 44, 240.

[4] Berkner, Wells and Seaton, *Ibid.*, 1939, 44, 301.

[5] C. Stormer, *Ibid.*, 1939, 44, 233.

MAGNETIC NOTES FOR JANUARY 1940

MAGNETIC conditions during January 1940 were more disturbed than those in the previous month. There were 2 days of *great*, 4 of *moderate* and 21 of *slight* disturbance as against 21 days of slight disturbance in January of last year. The quiet days numbered 4 as against 9 during January 1939.

The most disturbed day during the month was the 18th and the least the 26th. The daily characters are shown below in tabular form.

Dates of the month	Quiet	Disturbed days		
		Slight	Moderate	Great
January 1940..	13, 21, 26, 28	1, 2, 4-9, 11, 12, 14, 15, 16, 19, 20, 22-25, 27, 29.	10, 17, 30 31.	3, 18.

Four storms, 2 of moderate intensity and 2 of great intensity were recorded during the month as against none in January of last year. The mean character figure for the month is 1·06 while that for January 1939 was 0·71.

M. R. RANGASWAMI.

The Observatory,
Bombay,
February 6, 1940.

COSMIC RAYS

"THERE is some heretofore undreamed-of kind of activity taking place throughout the depths of space—an activity which manifests itself in continuously raining enormously energetic bullets of some kind (photons, electrons or both) from all directions upon the heads of us mortals who live on the surface of the earth." Thus wrote Dr. Robert Andrews Millikan, famous American physicist and Nobel Laureate, a few years ago in his book *Electrons*. Dr. Millikan assisted by Dr. Neher and Dr. Pickering have been during the last fortnight investigating the nature of these bullets of energy also called cosmic rays, in Bangalore. The Government of Mysore have very kindly placed at the disposal of these scientists all facilities, and the scene of this great scientific activity has been at the *Central Observatory*.

The most outstanding feature of these rays is their very high penetrating power, far surpassing either X-rays or Gamma rays. No less characteristic is the ionisation caused by their passage through matter. The atoms or molecules in their path are torn apart and mutilated to form ions, and the extent of ionisation is measured by observing the rate of discharge of an electroscope. Dr. Neher has developed a special type of electroscope employing very delicate quartz fibres coated with gold which automatically records on a film the rate of discharge, and hence the extent of ionisation, which in its turn is a measure of the intensity of the cosmic rays at the locality. Dr. Millikan sends up a pair of balloons connected by a long tape and carrying a case containing the Neher electroscope. On reaching very high altitudes of the order of 20 to 25 kilometres one balloon bursts, and the other, unable to lift the weight of the apparatus, comes down slowly without crashing. After recovery, the film is developed to study the rate of discharge of the electroscope at the different heights attained during the flight.

Another type of apparatus employed by Drs. Millikan, Neher and Pickering depends on the use of a Geiger-Muller Counter. This is a glass tube containing a hollow metal cylinder along the axis of which is stretched a metal wire. The tube contains a suitable mixture of gases at about ten centimetres of mercury pressure. On applying a sufficiently large potential difference between the wire and the metal cylinder a discharge occurs, but if the voltage is not enough there will be no discharge. Yet the gas inside will be in a sensitive condition. A cosmic ray shooting through ionises the gas and precipitates the discharge. This event is amplified and transmitted by a tiny radio-transmitter also carried up with the counter by the balloons. These radio signals are received suitably and made to record on a uniformly moving ribbon of paper.

Investigations so far have shown that these cosmic rays consist, in large part at least, of electrically charged particles hurled into our atmosphere from outer space. Their energies are stupendous. Potentials of the order of a thousand million—even ten thousand million—volts would be needed to give these high energies. As they approach the earth, they are deflected by the earth's magnetic field which, though weak, extends to a considerable distance. The cumulative effect on the cosmic ray headed towards the earth is then considerable. In fact, particles with energies less than what they would pick up under 17,000 million volts would be unable to reach the earth at the equator in India before they were turned back into space by the earth's magnetic field. The complete story of the influence of the earth's field on these rays at different altitudes, and in different latitudes reveals to us much that is new concerning their nature.

A study of the variation of cosmic ray intensity with the magnetic latitude, especially in the equatorial belt extending up to about 40° magnetic north, yields the most valuable information. Theoretical work by Störmer, Epstein and Le Maitre and Vallarta has indicated the importance of investigations in this belt. Dr. Millikan has for this reason conducted excellent tests at Peshawar (25° magnetic north), Agra (17° magnetic north) and Bangalore (3° magnetic north).

Another equally important investigation is to study the "East-West Effect". A set of Geiger counters mounted suitably constitutes a cosmic ray telescope, and helps to measure the abundance of the cosmic rays along any direction. When it is mounted with its axis slanting at about 45° to the vertical and carried up by the balloons, the counts indicated when the telescope is eastwards and westwards can be separated by an ingenious device employing a photoelectric cell. In the west the indication are more frequent and point to the entry of a large number of positively charged particles.

Experimental evidence gained till now has testified to the uniformity of the distribution of these cosmic rays over the celestial dome. Neither the sun nor the stars seem to have any influence on their intensity. Any process which gives rise to them is regarded as not happening anywhere in our galaxy. Such atomic or nuclear transformations as might be responsible for their origin do not find the conditions obtaining on the earth, on the sun, or in the stars favourable for their occurrence. This leaves us to seek their origin down in the remote depths of space where extremely low temperature, density and pressure prevail.

To account for the origin of at least these rays which have small penetrating power—though most powerfully ionising—Dr. Millikan formerly suggested that atoms of hydrogen in these regions occasionally fuse together to build up higher elements like helium, oxygen,

silicon, iron, etc. Dr. H. N. Russell has inferred from his astronomical studies that about ninety per cent. of the universe is still in the form of hydrogen atoms. Einstein has concluded that every process which releases radiant energy must be accompanied by a corresponding decrease of mass in accordance with his relation ($E = mc^2$). Actually it is known that the mass of every higher atom is less than the sum of the masses of the several hydrogen atoms which somewhere, somehow, somewhen close up together to form the complex atom. This is known as the "packing effect" and the deficit in mass denotes the amount changed into radiation. Four hydrogen atoms, on fusing together to form a helium atom, release energy estimated to be twenty-eight million electron volts. Likewise the formations of atoms of oxygen, silicon, iron and uranium are accompanied by the release of 116, 216, 460, 1,800 million electron volts respectively. But if there is a sudden annihilation of a hydrogen atom, one thousand million electron volts are released and in the case of helium 4,000 million electron volts.

On checking up these estimates with the experimentally found values for the energies of the cosmic rays, one finds that most of them correspond to the sudden annihilation *in toto*, and the complete transformation into cosmic rays of the whole mass of some very light elements like helium, carbon, nitrogen, oxygen and silicon. The atom building process with the transformation of only a part of the mass yields too small energies to be a possible explanation of their origin. But if the whole mass of, say, the carbon atom out in interstellar space has any chance at all of transforming itself wholly into an electron pair there would thus be produced cosmic ray electrons of 6 billion electron volts energy. That sort of transformation applied to a hydrogen atom would similarly produce cosmic ray electrons of an energy of ½ billion electron volts and oxygen would thus yield 8 billion electron volts. This is precisely where the experiments of Bowen, Millikan and Neher prove conclusively that by far the greater part of the measured cosmic ray energy lies. Our knowledge of the universe so far reveals no other source of such enormous energies as are actually found in the cosmic rays; and this suggested source seems to yield approximately the correct values. This may of course be an accidental coincidence, but the India experiments are expected to throw more light on this point. Astronomers are now using the idea of the building of the heavier atoms out of hydrogen, and thus the partial transformation of mass into radiant energy to explain the age-long supply of heat energy to the sun. Dr. Millikan, who formerly used this same process to account for cosmic rays, now finds this process inadequate for the purpose. But he now finds that the complete transformation of the mass of carbon, nitrogen, oxygen and silicon atoms into cosmic radiation would be adequate. These four elements too have recently been found by Bowen to be the elements that exist most abundantly in intersteller space.

The processes of partial or complete mass transformations suggested above are such as would be in line with the assumption of the universal validity of the second law of thermodynamics. Based on this law we have the speculations of Jeans and Eddington, which carried to logical extreme imply that the universe is fated to suffer a "heat death" of final extinction of activity of all sorts. In spite of this, many scientists and philosophers wish to question the validity of this reasoning. But on this question there has never existed any experimental evidence of any sort. Yet, to deny the possibility of the transformation of radiation back into matter anywhere in the universe on the basis of our experience here on the earth represents a use of the dogma of "the heat death" of the universe. This is in no way different from the use of the worst form of ecclesiastical dogma. Dr. Millikan, the true scientist that he is, has never hesitated to express his disapproval of both kinds of dogmatism. In his opinion the dogma of the heat death of the universe would imply that we infinitesimal mites on a speck of a world know all about the universe and its workings, or more specifically that the radiation laws which appear to hold here cannot possibly have any exception anywhere else. And this is just the sort of sweeping generalisation which has lured scientists into error several times before. The situation is summed up crisply by G. N. Lewis who says that "thermodynamics gives no support to the assumption that the universe is running down. Gain in entropy always means loss of information and nothing more".

Up to the present, the study of cosmic rays has yielded no significant bearing on the question whether the universe is ultimately running down along a one-way course or whether there are processes which maintain it in equilibrium. These are questions more within the realm of the philosopher and the metaphysician and entirely outside the canvas of the experimental physicist.

P. SRINIVASA ROW.

RESEARCH ON MEDICINAL AND POISONOUS PLANTS*

WORK on medicinal plants was started by my colleagues and myself nearly twenty years ago. Our first main objective was to make India self-supporting by enabling her to utilize drugs produced in the country. There are a number of drugs of established therapeutic value which are in use in the pharmacopœias of different countries. The majority of these grow wild in great profusion in many parts of India and a certain number are even cultivated. If these resources could be utilized and the finished products manufactured, treatment of many diseases could be brought within the means of the Indian masses, whose economic condition is unfortunately of a very low order.

A number of important drugs, extensively used by the medical profession, however, are neither found wild nor have so far been cultivated in India. Cultivation of such drugs is very important from an economic point of view, and scientific research in this direction, as is being carried out in other countries, would be very fruitful. It is a matter for regret that India is still importing large quantities of crude drugs in spite of the fact that practically every conceivable pharmacopœial drug can be grown within her bounds. The history of the cultivation of cinchona, eucalyptus, digitalis, etc., in India, clearly shows that the cultivation of medicinal plants is pregnant with rich possibilities if taken up on proper lines. It is gratifying to note that more and more interest is now being taken in this direction. A list of medicinal plants which might with advantage be cultivated has been prepared and is available for those interested in such development.

Our second objective has been to discover remedies from the claims of *Ayurvedic, Tibbi* and other indigenous resources suitable for employment by exponents of Western medicine. Since the period of decay and resuscitation of old systems of Indian medicine, many of the effective remedies have been lost while a number of uncertain ones have crept in. Belief in their efficacy originates in some cases from the teachings of the ancient commentators and is based on clinical data, but in others has no foundation whatever. Nearly two hundred medicinal plants have been investigated in our laboratories and some of these have been shown to be of practical utility. Apart from this, the negative value of such investigations should not be lost sight of. Whatever the merits or demerits of the indigenous systems may be, it should be remembered that they minister to the needs of nearly 80 per cent. of the population of this vast country. It is, therefore, the primary duty of any research organisation existing in this country to evaluate their effectiveness and practical utility.

COLLECTION OF DRUGS

During the last twenty-five years several drugs of Indian origin have assumed considerable importance from the point of view of foreign trade. Many firms of drug manufacturers in this country also use the locally produced raw materials for the manufacture of the finished products. It is a matter of very great concern, therefore, that the crude drugs collected locally are often not up to the required standard and this has resulted in considerable economic loss. Collectors of medicinal drugs growing in a state of nature, and the present and prospective cultivators should bear in mind that there are certain factors which have to be considered in order to obtain the standard product. There is a good deal of variation in the active principles in the different parts of a plant and in different seasons in the same part of the plant. Plants collected at the proper time, when the active principles are at their maximum, give very effective results. Collection of drugs in the case of plants under cultivation can be carried out under controlled conditions. It has, however, to be admitted that the ideal conditions for the collection of even many of the common and important medicinal plants are not known with precision and research is urgently needed to determine the time when the active principles are at their maximum under the environments existing in this country, as was done by the Dutch in Java in the case of cinchona. If this could be systematically carried out, India could supply the whole of the world with medicinal 'herbs'.

POISONOUS PLANTS

Intimately connected with the study of medicinal plants is the problem of poisonous plants, but till recently little attention has been paid to this study in this country. They contain chemical constituents which, if introduced into the body of an animal, in relatively small quantities, act deleteriously and may cause serious impairment of bodily functions or even death. Apart from the utilisation of their potent properties in the treatment of diseases to alleviate the sufferings of man and animals, there appears to be no doubt that they are a source of great menace in India through poisoning of livestock.

We are concerned in this country with the welfare of 360 millions of human beings, as well as with that of roughly 220 millions of the bovine population out of a total of about 730 millions in the whole world. Even in its present unsatisfactory condition, the cattle industry contributes roughly about 10,000 million rupees to the annual agricultural income of 20,000 million rupees of this vast country. The importance of plants which are poisonous to livestock, will thus be readily understood. It is a matter for regret that no systematic attempts have been made in India so far to investigate these plants on scientific lines with a view to devising means by which this menace could be controlled.

Another aspect of these plants which will repay study concerns those which have insecticidal

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* From the Presidential Address by Brevet-Col. R. N. Chopra, SC.D., I.M.S. (Retd.), Director, School of Tropical Medicine, Calcutta; Annual Meeting of the *National Institute of Sciences, of India*, Madras, 1940.

and insect repellent properties. Losses inflicted upon India by insects are enormous and at a moderate estimate are calculated at 2,000 million rupees annually and over a million and half of human lives. Effective defence against these enemies of social and economic progress should materially reduce this enormous wastage and facilitate national development. The finding of cheap insecticides for the diverse needs of agriculture, destruction of household pests, prevention of vectors of such diseases as malaria and many others borne by insects commensurate with the limited means of the masses in India, are important problems to which little attention has been paid till recently. Vegetable insecticides are preferable to mineral ones, as these are less deleterious to man and warm-blooded animals generally, and as they are also less harmful from the point of view of agriculture.

HERBARIUM OF MEDICINAL AND POISONOUS PLANTS

One of the chief difficulties in connection with our work on medicinal and poisonous plants has been the proper identification of the material to be investigated. The descriptions of plants given in the literature on indigenous medicine are meagre and vague and this has resulted in considerable confusion. Many drugs are sold under different names, different drugs under the same name, and even the learned *Kavirajs* and *Hakims* cannot say with certainty which species are meant in the old text-books. No authentic specimens of even well-known remedies were ever collected and preserved by the exponents of indigenous medicine and no actual comparison is possible. With a view to combating this state of affairs it was considered desirable to collect authentic specimens of all the plants with alleged medicinal or toxic properties and after proper identification preserve them for the purpose of comparison. This work has progressed and it has been possible to collect 6,000 specimen sheets of about 16,000 species. About 900 species have yet to be obtained to complete the collection of all the known medicinal and poisonous plants growing in India. The present collection will, it is hoped, form the nucleus for a *National Herbarium* of medicinal and poisonous plants.

SURVEY OF MEDICINAL AND POISONOUS PLANTS

A question of great economic importance is the working out of the distribution of medicinal and poisonous plants in this country. The distribution of many plants as described in literature is often vague and inaccuracies, which have crept in, have been passed down from one publication to another. To avoid confusion for future workers in the field, a stock-taking of the present distribution of medicinal and poisonous plants was started. All the available literature is being consulted and herbaria all over India are being scrutinized. Valuable information is thus being collected, and this will be of practical value to those interested in harnessing the natural resources of the country. This will also give indications of suitable localities for the cultivation of medicinal plants.

From the point of view of poisonous plants also, this survey is of great practical value, as once the occurrence of the harmful herbage in grasslands and other localities open to grazing for livestock are mapped, it should be possible to adopt measures for the protection of livestock against the menace of poisoning.

From the brief review, it will be apparent that the study of medicinal and poisonous plants offer a stimulating field for investigation and is of great economic importance to India as well. A teamwork between chemists, botanists, pharmacologists, agriculturists and clinicians is needed before problems of this nature can be properly tackled and solved. Every attempt should be made to develop this teamwork between scientists in this country, if any tangible results of economic and agricultural importance is to follow.

SCIENCE NOTES AND NEWS

Anomalous Diffusion.—Freundlich and Krüger, in a recent paper (*Trans. Faraday Soc.*, 1939, 43, 981) have given a direct proof of "diffusion rétrograde". If salts (potassium chloride, potassium sulphate, sodium chloride) diffuse in an aqueous solution of a second solute (quinone, succinic acid), the latter being uniformly distributed at the outset, the second substance markedly changes its distribution in the region where the concentration gradient of the salt is steep. A correlation has been possible between this effect and the influence of salts on the solubility of the second solute. If the solubility of the second solute is decreased by the salt, as is the case, for instance, with quinone and potassium sulphate, then a decrease of quinone concentration occurs on the salt side of the boundary and an increase occurs on the water side. If the solubility of the second solute is increased by the salt as is the case with quinone and potassium nitrate, the shift in concentration has the opposite sense.

K. S. G. D.

* * *

De Haas-Van Alphen Effect.—At ordinary room temperature, the diamagnetic susceptibility of a crystal of pure bismuth is independent of the magnetic field in which the crystal is placed. When the temperature is lowered, however, the susceptibility is no more independent of the field strength but is a complicated periodic function of the same. This periodicity depends on purity of the crystal as well as temperature. De Haas and Van Alphen[1, 2, 3, 4] were the first to find this effect. This was later studied by Van Alphen[6] as well as by Shoenberg and Zaki Uddin[7,8] at Cambridge. A theory

was given by Peierls[5] and Jones.[11] Further the results of Shoenberg and Zaki Uddin[7, 8] have been made the basis of a new theory by Blackmann.[9] This effect is not, however, found in the case of pure antimony crystals down to 4° K.[15]

The effect is not present at 77° K, but at the temperature of liquid hydrogen (20° K) the periodic curve is obtained; if solid hydrogen (14° K) be employed the effect becomes more pronounced while with liquid helium (4° K) it comes out prominently. If impurities be added (Te or Pb) the curve changes its shape, and if added in large quantities, the effect disappears altogether. Recent observations of Shoenberg[10] show that if temperatures less than 4° K be used, the curves become even more pronounced and that it is possible to obtain significant information about free electrons in bismuth. (See Mott and Jones[14] as well as Bates[13] work.)

M. ZAKI UDDIN.

1 W. J. de Haas and P. M. Van Alphen, *Leiden Comm.*, 1930, **212** a.

2 Shubnikov and W. J. de Haas, *Ibid.*, 1930, **207.**

3 W. J. de Haas and P. M. Van Alphen, *Ibid.*, 1930, **208.**

4 ———, *Ibid.*, 1932, **220** d.

5 R. Peierls, *Z. f. Phys.*, 1933, **81**, 186.

6 P. M. Van Alphen, *Dissertation*, Leiden, 1933.

7 D. Shoenberg and M. Zaki Uddin, *P.R.S.*, 1936, **156A**, 701.

8 M. Zaki Uddin, *Cambridge University Dissertation*, Nov. 1937.

9 M. Blackmann, *P.R.S.*, 1938, **166A**, 1.

10 D. Shoenberg, *Ibid.*, 1939, **170A**, 341.

11 H. Jones, *Ibid.*, 1934, **147A**, 396.

12 L. Landau, *Z. f. Phys.*, 1930, **64**, 629.

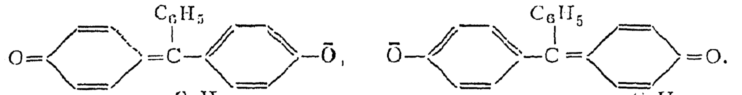
13 L. F. Bates, *Modern Magnetisim*, Cambridge University Press, 1939.

14 N. F. Mott and H. Jones, *Properties of Metals and Alloys*—International Monographs on Physics, Oxford University Press, 1936.

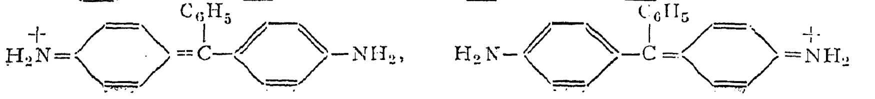
15 D. Shoenberg and M. Zaki Uddin, *Cam. Phil. Soc. Proc.*, 1936.

* * *

A Theory of the Colour of Dyes.—It has come to be recognised during recent years that the colour of dyes is associated with the resonance of electric charge from atom to atom of the dye molecule. Because of the complexity of the problem, however, it has not been easy to expand this idea into a theory of colour, permitting the rough quantitative calculation of the frequencies and intensities of the absorption bands of dyes. L. PAULING has now developed a theory of this nature (*Proc. Nat. Acad. Sci.*, U.S.A. 1939, 25, 577). The long-wave-length absorption band of a dye such as benzaurin or Dobner's violet has been associated with resonance of the type,



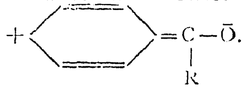
Benzaurin.



Dobner's violet.

the normal state involving the symmetric combination of the structures and the upper state their antisymmetric combination. Other intermediate structures are also involved, but some of them are not stable enough and can be neglected. A secular equation is then set up similar in form to that obtained in the molecular-orbital treatment: each root of this equation represents an energy level of the molecule.

The C = O in all ketones involves resonance of the structures $R_2C = O$ and $R_2\overset{+}{C} - \overset{-}{O}$. When the C = O is conjugated with an unsaturated or aromatic group as in acetophenone, etc., resonance with other structures occurs, such as



This deepens the colour of the substance, the CO absorption being shifted from the ultra-violet to the visible region. The bathochromic effect of conjugation is limited by the Coloumb energy of separating the charges in the molecule. Thus in a proton-donating solvent such as concentrated sulphuric acid the energy of separation of the charges is decreased by the field of the environment, and the colour becomes deeper. In a great many dye molecules, it is the CO group that is the source of the resonating charge. The theory permits quantitative predictions to be made regarding intensities of absorption bands. The band of longest wave-length is predicted to be the most intense band for many dyes. The agreement between predicted and observed values of the integrated absorption coefficient is good.

M. A. G.

* * *

The Use of Zinc Chloride for Delinting Seed Cotton.—An acidic solution of zinc chloride (zinc chloride dissolved in twice its weight of concentrated hydrochloric acid) which has the action of dissolving pure cellulose has been used successfully for the removal of the fuzz from cottonseed intended for sowing and has been further found to improve both the germination and the seedling vigour (B. N. Singh *et al*, *Ind. Jour. Agr. Sci.*, 9, Part V). A minimum duration of five minutes of soaking was found necessary for complete delinting. Doses of five to fifteen minutes' duration were necessary for activating germination; such treatments initiated early start higher germination percentage and early completion of germination. The seedlings from the treated seeds were taller, more healthy and had a better stand than the controls. The experiments were conducted in sand cultures. The studies can, with advantage, be extended to field trials and the comparative cost of the new method as against the current methods referred to, also worked out.

A. K. Y.

The Placenta of the Dog-fish.—Since the time of Aristotle, the development of a special structure for the exchange of nutrition between the parental and the fœtal Elasmobranchs is known. But while more attention has been paid to the uterus and its structure, no complete account of the placenta is known except in Mustelus. The pre-natal, pregnant and post-natal uteri of *Scoliodon sorrakowah* and *S. palasorrah* of the Indian seas have formed the subject-matter of an interesting paper by Miss G. Mahadevan (*Proc. Ind. Acad. Sci.*, 1940, B. 1, p. 1). Glandular structures are discovered in the uterus of pregnant *C. sorrakowah*; each embryo with a shell membrane is enclosed in its own compartment. The uterus is hollowed out in each compartment into a trophonematous cup into which the spongy yolk-sac fits in. Simple or branched appendicula arise from the placental cord. In *S. palasorrah*, these folded portions of the yolk-sac comes into greater contact with the villi in the trophonematous cup.

* * *

Chromite Deposits in Bombay.—The existence of a considerable quantity of chromite ore in a part of the Bombay Presidency readily accessible by sea is reported by the Geological Survey of India. Owing to its low grade the ore will not be readily marketable so long as high grade ores are available but there are industrial possibilities for the ore in the manufacture of potassium dichromate; similar low grade ores are used in the dichromate industry in Russia.

The major occurrence is near Kankauli in the Ratnagiri District and a smaller deposit is found near Vagda in the Savantvadi State. Both places are accessible from the ports of Malvan and Devgad which are connected by motorable roads.

Samples of the ore collected from both these localities were analysed in the laboratory of the Geological Survey of India and the chromite content was found to vary between 31 and 39·37 per cent.; the Vagda ores were found to be richer than the Kankauli ores.

* * *

Lloyd Barrage Research.—About Rs. 24,200 will be provided by the Imperial Council of Agricultural Research to the Sind Government for a scheme of sub-surface investigation work in the Lloyd Barrage Area. The scheme is an important one because Sind has an area of 1,122,000 acres under rice.

Some extension work has already been approved by the Advisory Board. Under this soils will be studied to prepare a scientific system of soil classification necessary for agricultural development and for predicting the behaviour of soil under irrigation. The sub-soil investigations will be extended to include seasonal and depth movement fluctuations in the composition, the relationship between the composition of the irrigation water and sub-soil water and the influence of sub-soil water on the moisture and salt profile.

In the short period during which the Barrage Canal has been supplying irrigation water on the Right Bank of the *Indus*, data yielded by investigations already made by the Sind Government, have brought to light a serious rise in the sub-soil water table in large parts of the area irrigated by the Rice Canal and the North-Western Perennial Canal system.

In the course of the next 10 years the work is expected to produce results of the greatest value to other Provinces in India and may be of considerable scientific interest to the world in general.

* * *

Researches on Indigenous Drugs.—The Imperial Council of Agricultural Research has allocated Rs. 44,000 spread over a period of three years for a scheme of research into the indigenous drugs of India, with special reference to their toxicology.

The programme of work, which will be conducted at Madras, provides for a scientific study of indigenous drugs of reputed efficiency, and of plants likely to prove of therapeutic use in veterinary practice.

Arrangements have also been made, whereby the Director of Veterinary Service, Madras, would investigate plant poisoning utilising his own staff and the Veterinary Investigation Officer, Madras.

* * *

"*Udyama*" Wheat Special Number.—The well-known Marathi monthly *Udyama Magazine*, devoted to practical information on Agriculture, Industries and Commerce, has recently issued a Special Number on wheat. This number comprises a series of well-written articles relating to cultivation, nutritive value, the more common diseases of wheat and their prevention, marketing, etc. These articles have been contributed by specialists who have devoted considerable attention to the study of the different aspects of the wheat problem. The Editor deserves the warm praise of the Marathi-knowing public for bringing together in one number, much valuable information on one of India's important agricultural crops.

* * *

Tuberculosis in Elephants.—Mr. Devadoss Pillai, Inspector of Livestock, Calicut, has recently reported a rare case of tuberculosis in an elephant (*Ind. Forester*, 1940, 66, 86). The animal was 29 years old at the time of death. Post-mortem examination revealed the presence of highly congested lungs, studded with tubercle nodules. Necrosis, caseation and calcification were prominent in both the lungs. Examination of sections of lungs clearly showed a caseating broncho-pneumonia in which acid-fast bacilli, indistinguishable from mycobacterium tuberculosis, could be detected.

* * *

The Health Organisation of the League of Nations.—The first War-time session of the Committee was held in November (20–24) 1939. India was represented by Sir Alexander Russel. This session was a particularly momentous one as the Committee was called upon to decide the future activities of the Health Organisation.

In considering the influence of war on public health, two factors have to be borne in mind. Firstly, movements of troups and population, lower standards of living, destruction and its

consequences such as the possible contamination of drinking water, etc., produce conditions highly favourable to the spread of infectious diseases. Secondly, migration of threatened populations from war zones give rise to several medico-social problems. Health authorities are concerned with the organisation of health services and are faced with problems of food supply and mobilisation of economic resources. The Health Organisation is, therefore, called upon to plan its work on different lines from peace-time conditions, and turn documentary material and past experience into full account.

To enable the Health Organisation to act without delay, an emergency Sub-committee was set up with powers to take immediate action in consultation with the President of the Committee. The Committee was instructed to take stock of the armoury of preventive and curative weapons made available by modern epidemiology, chemo-therapy and serotherapy.

The Committee was of opinion that its essential peace-time activities should be carried on to the fullest extent. Thus the permanent services—*Epidemiological Intelligence Service*, the *Singapore Bureau* and *Biological Standardisation*, will continue without interruption. The studies in progress—the enquiry into the *radiological treatment of cancer of the cervix uteri*, the preparation of the *unification of the various national pharmacopœiæ*, *malaria immunity and the biology of certain strains of plasmodium*, the co-ordination of *investigations on nutrition in the East* entrusted to the Coonoor (India) Laboratories, and the analysis of the *annual statistics of rabies*—will be continued.

* * *

Royal Asiatic Society of Bengal.—The annual meeting of the Society was held on February 5th, at the Society's headquarters, His Excellency the Governor of Bengal presiding.

The Hon'ble Mr. Justice John Lort-Williams, Kt., K.C., was elected President of the Council of the Royal Asiatic Society of Bengal. Bt.-Col. R. N. Chopra, Maharajadhiraja Sir Bijay Chand Mahtab, Dr. C. S. Fox and Dr. Syamaprasad Mookerjee were elected Vice-Presidents.

The *Elliot Prize* for scientific research was awarded to Mr. P. K. Chatterjee of Calcutta, the *Barcley Memorial Medal* to Major-General Sir Robert McCarrison, and the *Annandale Memorial Medal* to Prof. Frank Widenreich of Peiping.

A donation of Rs. 500 to the Society from Sir David Ezra, the retiring President, was announced at the meeting.

* * *

The Indian Botanical Society.—As a result of elections held at the Nineteenth Annual Meeting of the *Indian Botanical Society*, at Madras, on the 3rd January 1940, the Executive Council was constituted as follows:—

President: Dr. H. Chaudhuri (Lahore); *Vice-Presidents*: (1) Rai Bahadur Professor K. C. Mehta (Agra), (2) Dr. K. Bagchee (Dehra Dun); *Secretary*: Professor Y. Bharadwaja (Benares); *Treasurer*: Professor M. O. P. Iyengar (Madras).

Elected Members of the Executive Council: Professor S. P. Agharkar (Calcutta), Dr. P. L. Anand (Lahore), Dr. K. Biswas (Calcutta), Professor S. R. Bose (Calcutta), Professor T. Ekambaram (Madras), Professor S. L. Ghose (Lahore), Professor J. H. Mitter (Allahabad), Principal P. Parija (Cuttack), Dr. S. Ranjan (Allahabad) and Professor B. Sahni (Lucknow).

* * *

The Entomological Society of India.—The second general meeting of the Entomological Society of India was held at Madras on the 3rd January 1940. The General Secretary's Annual Report showed that during 1939 the membership of the Society rose from 44 to 87 and three more branches, *viz.*, those of Bihar, Bengal and South India were started in addition to the Punjab and Delhi Branches already existing. The Society started the publication of the *Indian Journal of Entomology* in 1939.

Dr. Hem Singh Pruthi (Imperial Entomologist, New Delhi) was elected President of the Society for 1940 and Mr. M. Afzal Husain as one of the Vice-Presidents from among the past Presidents of the Society. In consequence of Dr. Pruthi's election to Presidentship, Dr. N. C. Chatterjee of Dehra Dun was elected Vice-President and Mr. P. M. Glover of Namkum, Ranchi, a member of the Executive Council.

* * *

A series of papers on the cytology of *Ichthyophis* and *Uræotyphlus*, two Indian representatives of the Apoda (Amphibia) has formed the basis of the award of the D.Sc. degree of the Madras University to Mr. B. R. Seshachar (Department of Zoology, University of Mysore, Central College, Bangalore). No work has up till now been done on the chromosomes of any member of the Apoda and their number, form and behaviour in meiosis have been described in *Ichthyophis glutinosus* and *Uræotyphlus narayani* (*Zeitschr. Zellforsch.*, 1936, 1937; *Cytologia*, 1937; *La Cellule*, 1939). An interesting case of chromosome inversion in *Ichthyophis glutinosus* has also been recorded, perhaps the first instance of such a variation reported in any natural population of animals (*Cytologia*, 1939). The occurrence of ovicells in the testis of *Urœtotyphlus narayani* has been noticed, a feature hitherto unrecorded in the Apoda (*Proc. Ind. Acad. Sci.*, 1939). The origin of germ cells in the adult testis of the animals of this group has formed the subject-matter of another paper (*Zeitschr. Zellforsch.*, 1937). A new species of *Uræotyphlus* from South India has also been described (*Proc. Ind. Acad. Sci.*, 1939).

* * *

Lucknow University.—Mr. Hungenahalli Govinda Rao Sitarama Rao, M.Sc., is declared eligible to receive the Degree of D.Sc. in Botany. The topic of his thesis was "Morphological Studies of Living and Extinct Plants".

After graduating from the Mysore University, Dr. H. S. Rao became a pupil of Professor B. Sahni, Sc.D., F.R.S., first as a student of the M.Sc. class and later as a Research Fellow of the University. He worked under the guidance of and in collaboration with Prof. Sahni. Several of his research papers have already appeared in the *Proceedings of the Indian Academy of*

Sciences and in the *Records of the Geological Survey of India*. He is at present Officer-in-Charge of the scientific work at the *Fruit Research Station, Hessarghatta.*

* * *

University of Calcutta.—Mr. Kshitish Prasad Chattopadhyaya, M.Sc. (Cantab.), has been appointed University Professor of Anthropology for a period of five years with effect from January 1, 1940.

* * *

University of Mysore.—I. Examinations: The results of the Pre-Medical and M.B.B.S. Examinations held in December 1939 were published. They were as follows:—

	No. Examined	No. Passed
1. Pre-Medical	31	22
2. First M.B.B.S.	35	19
3. Second M.B.B.S.		
Part I (New Scheme)	13	12
(Old Scheme)	9	8
Part II (Old Scheme)	10	7
4. Final M.B.B.S. (Old Scheme)		
Part I	24	12
Part II	19	11

II. Lectures.—The following lectures were delivered:—

1. *University Extension Lectures*: (1) Swami Ojasananda of the Sri Ramakrishna Ashrama, Mysore, on "Yoga, its application to Life," *in English* at Mysore. (2) Dr. B. Sanjiva Rao, M.A., Ph.D., Professor of Chemistry, Central College, Bangalore, on "Our Chief Foodstuffs" *in Kannada* at Chamarajanagar and Mysore. (3) Dr. V. K. R. V. Rao, M.A., Ph.D. (Cantab.), Principal, Sheth Lalbhai Dalpatbhai Arts College, Ahmedabad, on "An Industrial Policy for India," *in English*, at Bangalore and Mysore.

2. *Special Lectures*: (1) Prof. Harold Hotelling, M.Sc., Ph.D., Professor of Economics, Columbia University, U.S.A., on "Econometrics and Economic Planning", *in English*, at Mysore. (2) Dr. Birbal Sahni, M.A., Sc.D., D.Sc., F.R.S., Professor of Botany, Lucknow University, on (*a*) "The Geography of India," (*b*) "The Fossil Plants of India," *in English*, at Bangalore.

3. *Endowment Lectures*: The Rt.-Hon. V. S. Srinivasa Sastri, P.C., C.H., Vice-Chancellor, Annamalai University, delivered at Mysore, a course of two lectures *in English* on "The Place of Women in Indian Social Economy" under the Dr. Sri. U. Abhayambal Memorial Endowment, founded by Mr. U. Ramachandran, B.A., B.L., Advocate, Madras.

III. Meeting of the Academic Council: A meeting of the Academic Council was held on the 27th January 1940. The propositions that were passed at the meeting included, among others, the following:—

(*i*) Transitory ordinance relating to the admission of passed S.S.L.C. candidates to the Intermediate Course in Arts and Science. (*ii*) Courses of Studies and Schemes of Examination in Geography for the Intermediate and the B.A. and B.Sc. Degree Examinations. (*iii*) Courses of Study and Scheme of Examination in Hindi as an optional subject for the B.A. Degree Examination. (*iv*) Addition of Urdu to the list of major subjects which may be offered for the B.A. Honours Degree Examination. (*v*) Inclusion of Immunology in the course of studies in Pathology for the M.B.B.S. Degree. (*vi*) A recommendation to the University Council to institute the Doctorate Degree in Science.

IV. Indian Statistical Conference: The Indian Statistical Conference was invited to hold a part of its third session in Mysore. The Conference was held on the 6th and 7th January 1940 under the presidency of Professor Harold Hotelling, M.Sc., Ph.D., Professor of Economics, Columbia University, U.S.A.

* * *

Industrial Notes

Protein Plastic from Gram Meal.—Dr. J. L. Sarin, M.Sc., A.I.C., Ch.E. (Lond.), Industrial Chemist to the Government of Punjab, and Mr. M. Y. Uppal are investigating the possibilities of employing pulses like *Cicer* for plastics. The results obtained with gram meal (*Cicer arietinum*) are of a promising character and the work is being actively pursued.

Cracking of Vegetable Oils.—In a recent issue of the Industrial and News Edition of the *Journal of the Indian Chemical Society* (1939, 2, 213), Dalal and Mehta have investigated, in considerable detail, the possibility of utilising vegetable oils as sources of liquid fuels like motor spirit, aviation spirit, diesel oil, etc. According to the authors, the production of oil-seeds in India exceeds seven million tons, which besides fully satisfying the varied requirements of the country, leaves a large surplus for export.

Three different procedures have been adopted for the cracking of vegetable oils, *viz.*, (*i*) passing over a catalyst in a tube, (*ii*) distillation in presence of metallic salts and (*iii*) pressure distillation. Coconut, groundnut, sesame and mowrah oils have been employed in the investigation. This is a problem of great importance which we hope will be continued by the authors to the successful establishment of a vegetable oil cracking industry in India, producing fuels for internal combustion engines, industrial solvents and crude oils.

Jute Research in India.—We are glad to note that the Jute Industry in India has after all awakened to the need for research as a means of combating the downward trend of its position, which has threatened to become a permanent feature of its normal peace-time existence. The second Annual Report of the *Indian Jute Cess Committee* bears evidence of this awakening and shows that a comprehensive programme to cope with the problems on a wide front has been taken on hand and that a satisfactory beginning has already been made. A marketing enquiry including transport, research on the cultivation, preparation and other agricultural aspects, the supply of improved seed, research into the technology of jute, trade statistics, and propaganda are the several directions along which work is to be carried on. The work of the year has generally been of a preparatory character, such as the construction and equipment of the laboratories, the getting together of the staffs, and the sowing of the first crops in accordance with the experiments planned and so on. Nevertheless, some notable pro-

gress has already been made in working out the technique of spinning trials and samples of many different varieties of outstanding merit have been examined and reported upon both as to spinning quality and chemical character. Much information has been collected on the production, movement and world stocks of jute and on the marketing side, the enquiry has sufficiently advanced to permit a report being drawn up. The Annual Report also gives a very interesting summary of information on the various other fibres and materials which are coming into use as jute substitutes, which shows that the menace of these substitutes is not a distant bogey but is likely to become a serious danger fully warranting the work that has now been taken in hand, perhaps not a day too soon.

A. K. Y.

Tung Oil Industry.—Specimens of Tung oil seeds and of the extracted oil, known in commerce as "Chinese Wood Oil", have lately been placed on show in the Industrial Section of the Indian Museum, Calcutta (Botanical Survey of India). The specimens have been acquired from various places in Assam, Bihar, Burma, Ceylon and China.

The oil is used in the varnish industry, in leather dressing and in the manufacture of oil-cloth, linoleum, soap, etc., and in electrical industries, in the manufacture of certain insulating materials. Aluminium tungate, formed by the action of the oil on aluminium oxide, serves as a good fireproofing and waterproofing material. The oil was extensively used during the last Great War as an essential ingredient for aeroplane paints and varnishes. Automobile manufacturers use it as an under-coat in body-finishing of motor cars.

In India, Assam and Bihar are the two Provinces where the plant has been successfully grown. Experiments in Assam have been distinctly encouraging. More than 1,200 acres are under Tung at Naogaon, and there are about 350 acres under Tung in several tea estates. There are also 10 acres under Tung near Ranchi in Bihar, besides about 7,000 trees in the local tea plantations. Efforts are also being made to introduce the plant in various other parts of the British Empire, where the climatic conditions are considered to be suitable.

The British Electrical and Allied Industries Research Association.—The Eighteenth Annual Report of this Association describes vividly the features relating to this organisation, its finance and general activities. The Association is essentially built up on the services rendered and now enjoys an assured position of usefulness in the industry. Research is an absolute necessity in any progressive industry and in a relatively modern industry such as the electrical industry, it is doubly important. The work of this Association is an outstanding example of what co-operation can do. It has formed *liaisons* with all important bodies in the British Electrical Industry, and receives suggestions from all sources. Research programmes are then built up and carried out under the close supervision of committees representing all the interests, thus securing that the results obtained will be appropriate to and readily utilised by all concerned and that all the available talent is pooled together. There are at present 96 committees covering the various programmes of research.

The Association has got its own laboratories and staff of research workers under the able directorship of Mr. E. B. Wedmore. It is financed by subscriptions and donations from different Manufacturers and Technical Associations and by the Department of Scientific and Industrial Research.

* * *

Announcements

The British Council, London, has decided to offer an annual post-graduate scholarship of £300, tenable for one year, to a selected graduate of a recognised Indian University, who desires to undergo in the United Kingdom, a course of study or research likely to lead to a definite contribution to knowledge.

The Government of India have decided to set up a Selection Committee in India to scrutinize the applications received and to recommend a few names to the Council for selection. Provincial Governments and local administrations have been asked to invite nominations from Universities or University Institutions for the scholarship to be awarded in 1940 and to make recommendations to the Government of India by April 15th, 1940. Candidates must not be less than 21, and not more than 27 years of age on October 1st, 1940, and must have obtained a degree at a recognised Indian University.

Woodhouse Memorial Prize. It is announced that a Silver Medal and books of a combined value of Rs. 100 will be awarded to the writer of the best essay on one of the following subjects:—

1. Importance of physiological studies in modern plant breeding.
2. Dominant species as an index of soil texture.
3. Modern methods of inducing mutations and polyploidy and their value for Indian agriculture.
4. Problems of wheat improvement in India.

The competition is open to graduates of Indian Universities and to Diploma holders and Licentiates of recognized Agricultural Colleges in India, who are not more than 30 years of age on the date of submission of their essays. The length of the essay should not exceed 4,000 words. The essay should be forwarded to the *Director of Agriculture, Bihar, Patna, before 30th June* 1940.

Indian Science Congress, Benares, January 1941.—The Agricultural Sectional Committee proposes to hold Discussions on the following subjects during the next session of the Indian Science Congress to be held at Benares early in January 1941. Those who desire to contribute papers to the Discussions are requested to communicate with Dr. C. N. Acharya, Recorder for the Agricultural Section, Indian Institute of Science, Bangalore.

1. Drought resistance in plants.
2. The need for the exploration of wild forms for the improvement of crops.
3. Quality in crops.

Indian Research Fund Association.—A training course in practical nutrition work will be given in the *Nutrition Research Laboratories*, Coonoor, from April 15 to June 20, 1940. Candidates who wish to take part, should apply in a form obtainable from the Director, *Nutrition Research Laboratories, Coonoor*. The number of vacancies is limited and only candidates engaged in occupations, in which a knowledge of nutrition is likely to be of value, will be considered. No fees are charged.

Chronica Botanica.—From January 1940, *Chronica Botanica* is appearing as a Weekly. This international plant science Weekly, gathers all the scientific, professional and personal news, notes and comments that may help plant scientists (now over 80,000 in about 4,000 institutions) with their current work and the planning of new projects. It does not duplicate any of the 2,000 other plant science journals, publishes no original research, but brings together all information which may serve to promote useful relations, co-operation and understanding. (Editorial & Publishing Office: C/o The Arnold Arboretum, Jamaica Plain, Mass., U.S.A.)

Messrs. Annual Reviews Inc., Stanford University P.O., California, announce that the second volume of the *Annual Review of Physiology* will be released from the press in March 1940. It is expected that twenty critical surveys in the field of physiology will be included on subjects of interest to the specialist in experimental biology, biochemistry, physiology, neuropsychology and medicine. Price per copy $5.

The ninth volume of the *Annual Review of Biochemistry* is expected to be issued in May 1940. Twenty-nine subjects will be critically reviewed. The volume will comprise approximately 750 pages, complete with author and subject indexes. Price per copy $5.

* * *

Air-breathing Fishes.—There was an exhaustive and very critical exposition, rising sometimes to classic heights, of the structure, evolution and the present-day distribution of these interesting forms of fishes by Dr. B. K. Das, Professor, Osmania University, at the Zoological Section of the *Indian Science Congress*, held recently at Madras. Those that attended the sectional meeting, will always remember not only the vivid presentation of the theme but also, what was a strikingly novel departure from the usual procedure, the exhibition of lantern slides and cinematograph films which must have been made with great skill and at considerable expense. Perhaps, this is the first occasion when cinematograph films of the actual land migrations of these fishes, their general habits in the water and their air-breathing processes were demonstrated. Dr. Das deserves warmest congratulations on his producing not only an interesting and complete memoir on this subject which had formed his study and research for several years but on his excellent contributions at the joint meetings and sectional discussions. He dealt with the following subjects: (1) Importance of the Study of Marine Zoology in India, and (2) Share of Universities in the Development of Applied Entomology, in his characteristically exhaustive and practical manner.

* * *

We acknowledge with thanks receipt of the following:—

"Journal of Agricultural Research," Vol. 59, No. 9.

"Agricultural Gazette of New South Wales," Vol. 51, Pt. 1.

"Journal of the Royal Society of Arts," Vol. 88, Nos. 4541–44.

"The Philippine Agriculturist," Vol. 28, No. 8.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, Nos. 11 and 12.

"Biochemical Journal," Vol. 33, No. 11.

"Journal of Chemical Physics," Vol. 7, No. 12; and Vol. 8, No. 1.

"Journal of the Indian Chemical Society," Vol. 16, No. 11.

"Calcutta Review," Vol. 74, No. 1.

"Chemical Products," Vol. 3, Nos. 1 and 2.

"Comptes Rendus," Vol. 24, No. 9 and Vol. 25, Nos. 1, 3 and 5.

"Experiment Station Record," Vol. 81, No. 6.

"Indian Forester," Vol. 66, No. 2.

"Transactions of the Faraday Society," Vol. 35, No. 224.

"Indian Farming," Vol. 1, No. 1.

"Genetics," Vol. 24, No. 6.

"Industrial and News Edition of the Indian Chemical Society," Vol. 2, No. 4.

"Journal of the Indian Chemical Society," Industrial and News Edition, Vol. 2, No. 4.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 35, Pt. 3.

"Review of Applied Mycology," Vol. 18, No. 12.

"The Mathematics Student," Vol. 7, No. 3.

"The Bulletin of the American Meteorological Society," Vol. 20, No. 10.

"Journal of the Indian Mathematical Society," Vol. 3, No. 8.

"Indian Medical Gazette," Vol. 75, No. 1.

"American Museum of Natural History," Vol. 44, No. 5.

"Journal of Nutrition," Vol: 18, No. 6.

"Nature," Vol. 144, Nos. 3658–61.

"Sky," Vol. 4, Nos. 2 and 3.

"The Lingnan Science Journal," Vol. 19, No. 1.

"Indian Trade Journal," Vol. 136, Nos. 1751–55.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 9, Pt. 4.

"Arkiv Zoologi," Band 31, Nos. 1 and 2.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

January 1940. SECTION A.—B. POORNACHANDRA RAO: *Intensity of Raman lines in carbon tetrachloride.*—Assuming that the polarisability of carbon atom is negligible, the mean polarisability for CCl_4 and the intensity of the Raman line corresponding to the total symmetric expansion have been calculated and found to agree satisfactorily with observations. S. S. PILLAI: *On m consecutive integers—I.* S. S. PILLAI: *Generalisation of a theorem of Mangoldt.* R. S. VARMA: *On the polynomial* π_n (x). N. V. SUBBA RAO AND T. R. SESHADRI: *Use of mercuric acetate in organic preparations—Part II. Some experiments on its use as an oxidising agent.*—It is found that progress of oxidation cannot be followed by weighing the mercurous acetate precipitated, as the solvent also undergoes oxidation. J. BHIMASENACHAR AND K. VENKATESWARLU: *Ultrasonic velocities and adiabatic compressibilities of some organic liquids.*—Fourteen organic liquids and the chief constituents of six essential oils have been measured. G. V. L. N. MURTY AND T. R. SESHADRI: *Raman effect and chemical constitution. Influence of constitutive and other factors on the double bonds in organic compounds—Part III. Effect of the benzyl group on the C = O bond in esters.*—The benzyl group resembles closely the alkyl groups in the influence on C = O frequency. M. W. CHIPLONKAR: *The distribution of temperature in the lower stratosphere.*—It is very probable that the rise of temperature above 18 m. observed in tropics is due to ozone. B. D. SAKSENA: *Raman spectrum and molecular association in formamide.*—Raman lines and their polarisations have been studied for formamide and its aqueous solutions at different temperatures. The N—H frequencies should spread out into a band on account of the six possibilities of co-ordination existing for the NH_2 group. The molecules are largely polymers with some small percentage of monomers as well. S. BHAGAVANTAM: *Effect of crystal orientation on the Raman spectrum of calcite.*—Twelve spectrograms corresponding to different orientations have been studied. The observed results are satisfactorily explained by studying the selection rules in detail.

SECTION B.—(MISS) G. MAHADEVAN: *Preliminary observations on the structure of the uterus and the placenta of a few Indian Elasmobranchs.*—A detailed study of the placental features of Elasmobranchs. The material for study includes specimens of *Scoliodon sorrakowah, S. palasorrah, S. walbeehmi* and *Carcharinus dussumieri.* G. S. VERMA: *A new species of* Bombardia (B. hyalina *sp. nov.*) *occurring on dry twigs of* Thunbergia grandiflora *Roxb.*—The spores are hyaline and in mature condition consist of an oval head, a tail and two appendages, all of which are usually septate. S. M. DAS: *On* Herdmania (Rhabdocynthia) ennurensis *n. sp. (a new monascidian from Madras).*—The new species is distinguished from other existing species of *Herdmania* by the co-existence of the following characters: Body small and pear-shaped; atrial siphon enormously elongated, being almost equal to the length of the body; dorsal tubercle large, consisting of a double spiral; tentacles compound, in 3 alternating sizes and 24 in number; branchial sac with 7 folds on each side; 8–10 stigmata in each stigmatic area.

Entomological Society of India:

November 29, 1939.—D. N. ROY: *On the life-history and sex-ratio of* Chrysomia rufifacies, *a kind of sheep blow fly.*—*Chrysomyia rufifacies* Macq. (Diptera, Calliphoridæ) is widely distributed in this country. The so-called "hairy" maggots of the species are semi-carnivorous, preying on the larvæ, of other muscoid flies which breed in Carrion. They may even resort to cannibalism if other food is lacking.

Protein is essential for the development of eggs. Eggs are laid in batches. A first batch may contain between 153 and 386 eggs in laboratory-bred flies. The life-cycle occupies about nine days in summer. Contrary to Patton's opinion, the pharynx of the larva is provided with longitudinal ridges which are typically absent in carnivorous forms.

The most striking fact which was recorded was that the females of this species appear to be either male- or female-producing. Several batches of eggs from both laboratory-bred and wild flies were reared, always with the same result, namely, that the progeny consisted of members of one sex only. Two or three batches of eggs were obtained from some females and here too the sex of the progeny was the same in all batches. The results of some experimental matings indicate that the progeny of both sexes may be obtained when one male is mated to several females. This phenomenon, so far as could be ascertained, is unique among animals where biparental reproduction is the rule. *C. rufifacies* has not been cytologically investigated as yet, but even a plausible explanation is difficult to offer if it is remembered that mating is essential for oviposition. The phenomenon is also independent of food and season.

Indian Chemical Society:

November 1939.—N. R. DHAR AND E. V. SESHACHARYULU: *Nitrogen fixation in soil not wholly a bacterial process.* S. MUKHERJEE AND N. P. DATTA: *Electrochemical properties of stearic acid hydrosol—Part I.* N. P. DATTA: *Electrochemical properties of stearic acid hydrosol—Part II.* MUHAMMAD QUDRAT-I-KHUDA, ASUTOSH MUKHERJEE AND SUBASH KUMAR GHOSH: *Studies on the essential oil from the Rhizome of* Acorus calamus—*Part I. Isolation and examination of* Calamol. B. CHATTERJEE: *The electrochemical properties of colloidal silicic acid—Part I. Interaction with bases.* B. CHATTERJEE: *The electrochemical properties of colloidal silicic acid—Part II. Interaction with Neutral salts.*

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CURRENT SCIENCE

Vol. IX] MARCH 1940 [No. 3

THE DECLARATION OF THE RIGHTS OF MAN

The Lord shall fight for you, and ye shall hold your peace—Ex. 4:14.

THE complex and difficult resolutions tentatively formulated by Mr. H. G. Wells for public debate, have for their ultimate object the replacement of the existing chaotic political, economic and social conditions by a new world order. For the achievement of this very laudable and the most desirable object, he has invented a new machinery called the Declaration of the Rights of Man, somewhat analogous to its great historical forbears. It will be remembered in this connection that the Red Swede, Miles Bjornstam in Main Street once declared, "I am about the only man in Johnson County that remembers the joker in the Declaration of Independence about Americans being supposed to have the right to 'life, liberty and the pursuit of happiness'." We are perfectly prepared to believe that Mr. Wells and the eminent gentlemen associated with him, who propose to embark upon the somewhat perilous adventure of evolving permanent peace and harmony among mankind, do not themselves suffer from any malignant taint of national passions and prejudices, and that they possess the manly gifts of an international mind and universal sympathy, capable of seeing inspired visions of the lost Paradise, which, by the zealous and solid co-operation of the

forward nations, they evidently hope to recapture and plant somewhere in Europe or America, radiating sweet love and divine contentment to the remote corners of the world. But surely none of the sponsors of this new movement can have any reasonable faith in the objective existence of a Paradise, which, they know only too well, resides in the human heart, from which, however, it has been successfully banished by war-minded religions, pestiferous imperialistic impulses and the most baneful racial ideologies, together forming the most impious products of our sublime culture and competitive civilization. In the prefatory note setting forth the aims and objects of his new Declaration, Mr. Wells in his inimitable cheerful optimism explains that, if the mental confusion and political incompetence of the existing governments were removed, the advent of universal peace and lasting happiness would be rendered easy and natural, provided their foundation is laid on the decalogue he has propounded.

We admire Mr. Wells' courage. We honour his conviction. He has set before himself and his colleagues a task which would have shockingly baffled the great Founder of the official religion of their country. However, the world will bless them, if they succeed in assembling under a single white tent all the nations, peacefully and lovingly eating the fat of the land and drinking the dew of heaven, without baring their teeth at each other like belligerent rats. Everyone will agree with Mr. Wells when he says that we must fight against all that Hitler stands for,—violence, cruelty, bad faith, implacable aggression,—and that we must put in its place "a world and nothing less than a world at peace, where men can be free, without fear and so on". The appearance of Mr. Wells in his new character as a politico-ethical evangelist is explained by the fact that he claimed for the novel the powers of regenerating mankind, which he expressed thus, "it is to be the social mediator, the vehicle of understanding, the instrument of self-examination, the parade of morals and the exchange of manners". Where the politician has failed, perhaps the novelist may still succeed. His efforts must be supported by the energy and enthusiasm of all men and women, who approve of his resolutions in their present or in their amended form, though novelists like politicians are men and not giants.

We are not quite sure about the potency of the Declaration of the Rights of Man as a preventive machinery against dangers to international relations, or as an article of social faith for the establishment of non-violence, goodwill, tranquillity and economic progress. The word "Rights" generally implies prerogatives, privileges and immunities, and the individual, social and civic "Rights" have always an astonishingly awkward tendency to transform themselves into the "Rights" of States and Communities, thus giving rise to the principal classes of cases in economic competition in which governments intervene. If we trace the origin of human troubles, we shall discover that they began when primitive man first conceived the idea of possessing things exclusively, and developed the notion of defending his possession as a "Right" and of extending further aggrandisement also as a "Right". The significance and value of "Rights" are purely biological concepts, and their application as an ethical doctrine in the social and political spheres is always understood with consider-

able mental reservation. Far more fundamental to the cause which Mr. Wells and his supporters have proposed to establish, must be a clearer, a deeper and a more humane perception, and an intuitive practice of our duties and obligations toward our fellow-men, more than toward ourselves. Mr. Wells, wearing the wreath of literary supremacy with Mr. Bernard Shaw, is reputed to be a prophet, and it is therefore inexplicable why he has formulated the Declaration of the Rights of Man, while he and every man capable of thinking rationally and justly, must recognise the supreme need for a Proclamation of the Services of Man. How do individuals and nations exercise their rights? Is it or is it not a fact that in endeavouring to use and protect our rights we pretty nearly succeed in restricting the rights of others? Do not nations feel triumphant if, after considerable diplomatic exchanges and political negotiations, they finally succeed in either circumscribing or subordinating the rights of other nations? Do individuals and nations instinctively recognise and maintain the sanctity of their duties and obligations to each other? The fact is that in the case of "Rights", it is exhilarating to claim and protect special interests; whereas in the case of "Duties and Obligations", it is apt to be painful to practise the universalism of Christ. Between "Rights" and "Duties" there is a world of difference, and this difference explains the saying, "In this world there is tribulation."

It seems to us that the principal reason why we emphasise rights is because the spirit of Jehovah is still firmly ingrained in the heart of Christendom, and also because the tyranny of a mechanical civilization has subordinated the spiritual values of human relations. We are not convinced that, after centuries of religious teaching and educational influence, the human mind has become sufficiently righteous, meek and pacific to resist the temptation of abusing individual and national rights. In drafting the clause relating to personal freedom, Mr. Wells observes, "there again I admit difficulties. They centre upon the idea of conscription. It may be objected to the draft Declaration as a whole that it says much about rights and nothing about duties. It may be true that any one, who observes the rights of others to the full extent of the Declaration, has already undertaken very considerable obligations, but that does not dispose completely of this objection". There is an enormous mass of human document in the form of treaties, conventions and understandings establishing national goodwill and cordial relations, besides the Commandments and Injunctions of revealed religions, proclaiming the doctrine of the brotherhood of man and of universal love, and we have witnessed how in the past everyone of these articles of good faith, fellow-feeling and personal rights has been prosperously infringed or circumvented, throwing back society into barbarism and into the worshipping of the Golden Calf. Mr. Wells has not disclosed to us the authority which he proposes to invoke for the due and general observance of his new Declaration, but, if he relies on his ten clauses being received with open arms by mankind as a new Gospel for their temporal salvation, and on their being loyally and cheerfully followed without transgression, for at least a reasonable period, we are afraid that he is making too great a demand upon human nature,

There is a cartoon forming the frontispiece to *The Potwell Inn,* in which the figure is portrayed in the heavy panoply of a knight-errant, holding a mop instead of a lance. If we add a goose-quill to its accoutrements, the caricature might then come nearest to expressing Mr. Wells' present intention, of sweeping away the accumulated wrongs of the world and writing a new charter of human liberties, rights and peace. It would almost seem that the Gods in planning our existence, have deliberately mixed it up with strife and low cunning.

> intreated
> And Isaac ~~interested~~ the Lord for his wife, because she was barren, and the Lord was intreated ~~interested~~ of him, and Rebekah, his wife, conceived. And the children struggled together within her, and she said, if it be so, why am I thus. And she went to enquire of the Lord. And the Lord said unto her, two nations are in thy womb, and two manner of people shall be separated from thy bowels, and the one people shall be stronger than the other people, and the elder shall serve the younger.

The Lord blessed Jacob. He became the founder of modern diplomacy and science. In the Gospel according to St. John, we read that

> The Jews' passover was at hand, and Jesus went up to Jerusalem. And found in the temple those that sold oxen and sheep and doves, and the changers of money sitting. And when he had made a scourge of small cords, he drove them all out of the temple, and the sheep, and the oxen, and poured out the changers' money, and overthrew the tables.

Even that monumental Embodiment of Love could, in moments of grave provocation, lose temper and take the law into his own hands. Does Mr. Wells suppose that under the dispensation of his new Declaration the world is going to enjoy uninterrupted peace? Practically in all religions, the Lord is conceived as blood-thirsty, either directly engaged in conflicts, or assisting and encouraging His beloved people to wage war, "for the Lord, whose name is Jealous, is a jealous God".

Before the Israelites were led by Moses from Rameses to Succoth, the Lord enjoined him to "speak now in the ears of the people, and let every man borrow of his neighbour, and every woman of her neighbour, jewels of silver, and jewels of gold and raiment". The Lord proceeded to give the Israelites "favour in the sight of the Egyptians so that they lent unto them such things as they required. And they spoiled the Egyptians". There was a manifest need for the Ten Commandments thereafter.

"A world and nothing but a world at Peace" is mere rhetoric, or is a world reduced to the grey level of scientific dullness, and in the very nature of things we can hardly conceive its advent, though the ideal may be both desirable and necessary. The immediate object of Mr. Wells would, however, appear to be to secure for every man protection against the perils arising from individuals or from Governments, and for every nation, a reasonable measure of assurance to achieve its own destiny, freed from external intervention. In discussing measures for the attainment of this reasonable object, we often ignore the fundamental fact that human mind is incalculable and erratic, for it is really composed of separate layers, belonging to different epochs of its evolution, the animal, the savage, the childish and the civilized strata. The first is our inheritance, the second the race has passed through, the third a sort of mixture of the first two, which every individual

experiences, and the fourth is superimposed by the Church, the School and the Society. The extent of the existence and the degree of the activity of the first three layers necessarily depend on the strength and stability of the uppermost crust. In times of stress and crisis, the topmost bed often cracks; and we know the results. Before we proceed to discuss the practicability or otherwise of Mr. Wells' clauses, we must know how he and his distinguished colleagues propose to consolidate this very shaky top layer of the human mind into a Maginot line, withtanding the quakes of the subterranean trata. The foundation of Mr. Wells' Declaation is, in the last resort, the human mind, nd, before he sets out to achieve moral armony in the world, he must assure himlf of three things: a deeper understanding sed on the knowledge of life should velop sincerity of will; this sincerity of ll must purify the heart; and this loving art must spiritualise personal life. The h to individual freedom and to national ce does not lie through self-righteousness, ugh it be anointed with "a pound of ment of spikenard", but lies in our acity to own mistakes, to compromise rences, and above all rigidly to practise doctrine, "do unto others as you would one by". Mr. Wells' Declaration has not ity enough to survive another internal shock, and his resolutions are not to dissipate the causes which produce cts. We are all convinced that the nt campaign against Germany is just noral, and that the victory of the Allies olutely necessary for the independence overeign rights of all the smaller ean States, and that all the forces of ation" should be mobilised for the final overthrow of the spirit of aggression. The Allies hope that the termination of the present war will witness the birth of a new era of uninterrupted peace in the international life of Europe, and possibly Mr. Wells' Declaration is intended to pave the way for its inauguration. We shall cooperate.

Do the ten clauses drafted by Mr. Wells provide a basis for testing the preparedness of the world to receive the message contained in them? Students of contemporary political history must be aware of Clarence Streit's *Union Now* in which, after analysing the causes for the failure of the League of Nations, he has reached the conclusion, "that the only chance for the survival of the world as we know it and as it might be, would be pooling of some part of National Sovereignty and the eventual growth of a universal system of World Government which would be invincible against aggression and which would help against all economic and racial barriers". In examining the proposals for the establishment of a World Federal Union, the Marquess of Lothian in his book, the *Ending of Armageddon*, has drawn attention to the principal difficulties of a coalition between totalitarianism and democracy, the national pride in giving up National Sovereignty, and the colonial problems involving the political and economic control over other people. The politico-economic doctrines which we have drafted below would, in our judgment, constitute a measure of the willingness of nations to consider them as the basis for evolving a new code of international morality, and the first step in this direction must obviously be a complete demilitarization of religion and the annihilation of the war-mindedness of politicians.

1. We will share on an equitable basis the raw materials of the world in common with other nations, and will always abide by the decisions once accepted honourably by ourselves and the members of the Federation.

2. We will scrupulously respect the religions, customs, manners and other social practices and ceremonial rituals of every group or community of people to whatever cultural level they may belong, and we agree that interference with their right to follow their own observances, shall entail forfeiture of further participation on our part in the benefits of the Federation. We will seek the aid of liberal education rather than that of religion in reforming such practices as *sati,* human sacrifice and head-hunting.

3. We will interfere with the politics of no country, big or small: we respect its sovereign right to enjoy any form of government it may choose; where, however. its activities are apprehended to threaten the integrity of the Federation, the other members shall agree to join in imposing an economic boycott on the offending nation.

4. We will hold no community in economic or political subjection or vassalage, to whatever colour and civilization they may belong: we will agree to develop the material resources of any country and to organise its industrial possibilities only when invited to do so. and that strictly on a contract basis, without creating vested interests.

5. We will relinquish all exclusive privileges in respect of the great trade routes of the world, which shall be free for all, and which shall be jointly protected and maintained strictly for mercantile and traffic purposes, and which shall not be allowed to be used for carrying fighting vessels of any description.

6. We will export our industrial and agricultural products on the basis of a voluntary understanding between ourselves and the importing country, refraining from producing goods far in excess of home consumption so as to obviate trade rivalries and business competition.

7. We will spend out of our public revenues such sums as may be required only on those implements which may be employed for the preservation of domestic peace and order, and we solemnly bind ourselves to eschew all armaments capable of being employed against other nations.

8. We will acquire no fresh territory, except such vacant and uninhabited tracts as may be freely and willingly assigned to us by the unanimous consent of the Federation, in order to provide for our increasing demands. The boundaries limiting such grants shall on no account be infringed by us, and such countries shall not be used for extending our sphere of influence into the neighbouring territories.

9. We will establish a Federal Bank for controlling international currency, credit and exchange, and the Bank shall have power to refuse credit to any power infringing the articles of the Federation or engaging in a conflict with another federating member.

10. We will re-shape, re-adapt and re-construct our respective economic, industrial, racial, religious, cultural, social and political life in accordance with the general aims and purposes for which we establish the Federation, and in the process of re-arrangement we will so order individual life that, while it maintains absolute yet restrained freedom in all spheres of its activity, it is deprived of its potency for aggression abroad and terrorism within.

11. We will give up all existing monopolies and tariffs; we will relinquish our rights to hold colonies, dependencies, protectorates and mandated territories: we will arrange them on a fresh basis of

equity and justice such as may be determined by the Federation, subject to the doctrine of self-determination on the part of the colonies, dependencies, protectorate and mandated territories.

12. We will refer to the plenary session of the Federation all those classes of cases where international disturbance may be apprehended, such as, population problems, commercial policies, credit, currency and capital problems, transportation and raw material problems, diplomacy in relation to political and economic relations, political and social upheavals arising from dangerous ideologies and their reactions. We will uphold the supreme authority of the Federation in the settlement of these and other related problems, whose power to enforce its decision shall reside in the willingness of other members to boycott the offender socially, economically and politically.

We are perfectly aware that we are not sufficiently pure at heart and meek in spirit even to look at any of these propositions but we do not anticipate a better fate for Mr. Wells' Declaration of the Rights of Man. We have put forward the raw material out of which the legal and constitutional authorities might produce the general framework of a World Federation for discussion at a conference of accredited representatives of nations, after the happy termination of the war.

BARODA STATE FISHERIES

THE *Annual Report of the Department of Fisheries*, Baroda State, deals with the history of the fishery activities in the State from 1909, but it was not till 1936 that a Department of Fisheries was established and Mr. S. T. Moses appointed its Director in September 1937. Though the *Report* under review is full of details and constructive proposals, it is essentially of the nature of a preliminary report indicating the present state of fisheries of Baroda, the defects in their working and the difficulties that have to be encountered and overcome before any improvement can be effected. It is reported that the Director made a biological survey of the State and collected data about fish supply at various places. Several industrial experiments were carried out and already the scheme for the establishment of an aquarium and biological station at Port Okha, starting of fish farms at Velan and Balapur, setting up of fish hatchery at Muldwarka and a permanent fishery settlement at Kodidah (Velan) with an industrial depot for cold storage and curing and a smaller cold storage depot at Okha are under the consideration of the State authorities.

Considering the short period during which the work detailed in the *Report* has been carried out, a good beginning seems to have been made and we hope that in course of time the fisheries of Baroda will assume their proper place in the industrial development of the State. We take this opportunity to offer our congratulations to the Director and his small band of enthusiastic workers.

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THE STUDY OF MARINE ZOOLOGY IN INDIA

BY

PROF. B. K. DAS

(*Osmania University, Hyderabad*)

IT is unfortunate that our Indian seas, possessing such a rich potential wealth of animal and plant life, should remain a neglected field in Natural History, and that our knowledge of them at the present moment should be poor. No doubt, the study of animals in our seas is extremely interesting and important, but so far very little attention has been paid to them.

Our knowledge of the life in the Indian seas, which is of a diverse character, is very meagre indeed: we know practically nothing about the life-histories, spawning habits, food, rate of growth, migrations, distribution and seasonal variations about some of the most important marine animals, especially those of great economic importance, *viz.*, the fishes. The welfare and prosperity of a fish mainly depends upon its food, and this food, in many cases, consists of the marine planktons, *viz.*, both phytoplanktons and zooplanktons. Plankton-life is one of the most important biological, ecological and economic factors in the sea. As for instance, certain very important food-fishes (*viz.*, the Mackerel—*Rostrelliger sp.* or *Scomber*) feed chiefly on planktons, *i.e.*, mostly on Copepods, which again subsist on the diatoms; and thus it is evident that there is a very close relation between the planktons and many other important organisms in the sea.

Within the plankton-life itself there is so much of seasonal variation, diversity of form and occurrence, vertical migration, etc.; and the density and specific range of planktons are also very variable indeed,—depending upon several factors, among which the primary ones are the quantitative variation of the essential elements such as the silicic acid in the sea-water, which helps in the formation of the silicious skeletons of the diatoms; hydrogen-ion concentration; variations of temperature; sunlight; and salinity. All these factors are of very great importance to the life of planktons. In this connection reference may be made to the important works of Raben (1910), Murray, Moore (1915), Hornell (1923), Gray (1928), Atkins (1932), and others. It is true that in colder seas specific density of particular planktons is greater than that in the warmer seas, yet there is a vast field for work in this very fascinating branch of zoological study in India; and, it is also known that, so far as the number and variety of species are concerned, tropical waters are certainly always richer than the temperate and the arctic seas. In short, the economic aspects of planktons can hardly be overestimated, and it is for this reason and also because of the interrelation of life of other animals in the sea, very extensive investigations are now being done on them, both in the European as well as in American waters. In this connection particular mention may be made of the German Marine Biological Station at Kiel, where lately they have concentrated most of their attention on the intensive and extensive study of the planktons round about their seas.

However, our knowledge of the life-histories of the Indian Planktons is all

due to the earnest labours of Lt.-Col. R. B. Seymour Sewell (1912, 1913, 1926, 1929, 1932, etc.), but there is yet a vast virgin field to be explored. In addition to purely biological investigations of our seas, we must also direct our attention to certain other equally important factors which govern the conditions of life in the seas, *viz.*, the physico-chemical aspects of the water. This has been badly neglected in India, both so far as fresh-water as well as marine animals are concerned, without which our knowledge of the life in the sea would be most imperfect, and at the same time any satisfactory solution as to the life-histories of many of our sea-animals can hardly be achieved. In short, both hydrobiological and hydrographical work is absolutely necessary in order to understand the natural history of the fauna of our seas correctly. All the important factors should be most carefully and scientifically investigated and studied in order to get a correct idea of the rich wealth of animal life in our seas, which is waiting exploitation, and which will ultimately confer inestimable benefit on the vast population of India.

Animal-life in our seas, especially those at the sea-shore, sea-bottom, and also the swimming animals, drifting life (or planktons), the boring animals, coral reefs, etc., presents a most fascinating aspect for a systematic study. While there is such a diversified fauna of marine life found within the limits of the Indian shores, our knowledge of them is still imperfect to a degree due to sheer neglect and lack of interest.

It is of utmost importance that, if we really wish to develop and enrich our knowledge of Indian Zoology, we should know all about the structure and the natural history, bionomics, and physiology, of a vast assemblage of life that is present in our own seas, from the lowest to the highest. We should develop, encourage and create an interest in the study of marine zoology of our own country, which has been grievously neglected for such a long time. It is universally admitted that actual study of living marine animals is something far superior to, and more useful than, merely mechanically dissecting and drawing dead marine specimens in the class-room. Apart from the value of mere class-room study of morphology, marine animals are really very important from the point of view of the industries provided by the marine fisheries as well as the various products of very great value from the sea, which will greatly contribute towards the prosperity of our country. As a matter of fact, the whole success and prosperity of the marine fisheries entirely depend upon a complete knowledge of the life-histories of fishes, and it is here that the study of marine zoology can offer us the greatest assistance.

In order to create a real interest in the study of marine animals it is very necessary that the student of Zoology should go to the sea himself, and should actually observe, handle and examine the great variety of the most beautiful animals assembled together and found at the sea-coast; he must study their habits, ecology or bionomics, form and structure, behaviour and physiology on the spot and make his own notes from personal observations, and naturally he would thereby acquire a first-hand knowledge and information, which is the most important part of any scientific study. Such a kind of study is a vital necessity for the development and progress of marine zoology. As

a part of the work of any University curriculum our primary aim should be, first of all, to study thoroughly as many Indian marine types as possible, and then to examine the foreign types for the sake of critical comparison. In order to achieve this end specialists should take up the task voluntarily and engage themselves in working out the typical marine representatives from each class of animals, and a series of monographs should be prepared and published on the same line as the L.M.B.C. Memoirs. Of course, some admirable work has already been done in this direction in the Zoological Research Laboratory at Madras under the able guidance of Prof. R. Gopala Aiyar and also in the form of a series of valuable publications in the *Indian Zoological Memoirs* under the efficient editorship of Professor Karm Narain Bahl of the Lucknow University.

A place for the study of marine zoology should be selected and located at such a situation in India as would be most suitable for the study of marine life with the best of all desired conditions and environment, and at such a place an All-India Marine Biological Station should be established with a proper well-trained research staff, and planned on a research basis in the same way as the one we find at Plymouth, Port Erin, Roscoff, Heligoland, Naples, Kiel and Woods Hole. For this purpose an ideal place will possibly be the Krusadi Island, with, of course, several smaller research sub-stations that should also be gradually established at Madras, Trivandrum, Bombay and Karachi. Undoubtedly most valuable researches could be done at such a station. The whole idea is that the present resources of the Fisheries Department, under the Government of Madras at Krusadai, should be recognised as the nucleus for the future development and expansion of the All-India Marine Biological Station, and we should work together in full co-operation with the Fisheries Department. This would be most economical also, and in this way we shall be saving a lot of unnecessary initial outlay.

Every University in India which provides for training in Zoology should wholeheartedly co-operate with such a Marine Biological Station, and once a year both the staff as well as the senior students (say, the Honours and the Post-graduate) should visit the station, stay there for about 3 to 4 weeks, and study the marine animals in their natural home, and thus obtain a lot of most useful information about them. I should recommend that this should form a compulsory part of the University course for all B.Sc. Honours and the Post-graduate students. At such a place there should also be adequate arrangement for a vacation-refresher-course of lectures on marine animals, which would benefit the zoologists in general, such as we have at every coastal educational centre in Europe and America.

In view of the great diversity of form, structure and usefulness, marine animals are considered more important than the fresh-water types, and hence a thorough study of them is absolutely essential in order to raise the general standard of zoological teaching in India. The only way to do it will be for the Universities as well as the Provincial and the State Governments to take a very keen interest and a more active part and a fuller advantage of all the resources existing in a central Marine Biological Station which should co-ordinate the activities of

other smaller sub-stations mentioned above. I would like to suggest that there should be at least one zoological table created and maintained by each University at such a place for research work to be conducted by any member of its staff, and that a generous grant-in-aid should be given by each University as well as the Provincial and State Governments, in addition to a small fee paid by the individual worker himself, as is done in all Western countries for the maintenance of its establishment and upkeep.

ORGANISATION OF INDUSTRIAL RESEARCH*

It is thought that the occasion of the annual meeting of the Court of the *Indian Institute of Science,* Bangalore, which brings together so many influential representatives of science, industry and the professions, might be profitably utilised for concerting measures to promote industrial research. This may be done with a view, not only to strengthen this class of research in the *Indian Institute of Science,* but also, if possible, to co-ordinate the work done in all parts of the country, and prepare a plan and programme for the coming year.

There are special reasons why stress should be laid on industrial research at the present time and why it would be appropriate for a body like the Court of this Institute to consider this subject. In recent months educationists and business men have been loudly calling for measures to promote industries. The War has cut off supply, or enhanced the prices of chemicals, machinery and other commodities usually imported hitherto, and Government are also hard put to it for obtaining transport, military and other stores.

The question of promoting industrial research has been under the consideration of the authorities of this Institute for over six years. In the latest quinquennial Review, the Irvine Committee have outlined a scheme "to make applied research the first and most responsible duty of the Institute".

The Science Institutes, Universities and Colleges, have been spending considerable sums of money on research, but this is mostly on what is known as *pure research.* Since their activities are not regulated by any all-India Organisation which can speak with authority, there is no co-ordination or regulation of effort among research workers in the country just as there is, for instance, under Government auspices in Great Britain and the Dominions. This often results in duplication of work and waste of energy and money. There is no lack of scientific talent in the country to carry on industrial research or business ability to exploit such researches commercially but they are at present not systematically mobilised to serve the interests of industry.

The importance of application of scientific methods and knowledge to the practice of industries is now universally recognised. Several countries including the Dominions of the British Commonwealth have National Research Councils to organise and supervise work of this description, and recent indications are that the Government of India are also seriously thinking of a move in the same direction.

Until the Government of India find it possible to establish an institution like a National Research Council, it may be necessary to start a small *unofficial Committee* of representative scientists and business men to organise industrial research in War time.

A Committee of three members and three Honorary Secretaries is recommended. Each Secretary may be a leading Scientist or the head of a Science College or Institute.

The first duty of the proposed Committee would be to collect exact information of the kind and amount of research work that is now being done and the expenditure that is being incurred on it in the various educational and industrial centres in the country; then, by correspondence and discussion, to come to an understanding with the scientists and authorities of each centre as to the

* This memorandum prepared by Sir M. Visvesvaraya, K.C.I.E., was forwarded to the members of the Court of the *Indian Institute of Science*, Bangalore, for discussion at the meeting held on 23rd instant. The note contains recommendations which furnish material for a fruitful public discussion which we invite. It seems opportune that Sir M. Visvesvaraya has initiated deliberations in the first instance at the meeting of the Court and we would ask our readers to contribute their views and suggestions which will be gladly considered for publication.—*Ed.*

kind of research work and the character of research problems that would be of great value to their particular area in the present emergency. At least half a dozen University or other groups might be able to co-operate in this way.

In view of War emergency, it is suggested that *applied* research should be preferred as far as possible to *pure research*, and the research problems chosen should be distinctly *industrial* in character.

It is provisionally suggested that the small Committee proposed, be chosen from the front rank of scientists and business men in the country—not necessarily all from the members of this Court—to be entrusted with this responsibility. The election may, if necessary, be conducted by ballot and if the persons so elected consent to take up the work they may be entrusted with the responsibility of co-ordinating and stimulating work in this field, in the country as a whole, for one year, or till the Court meets in March 1941.

The Committee will be expected to prepare a combined plan and programme, as far as possible, after obtaining regional plans and programmes from the various centres of scientific activity in the country. The Committee will claim no authority of any sort, and will attempt no interference with the working of the existing institutions; but its members, by their knowledge, experience, breadth of view and tact, should be able to persuade all centres to co-operate and bring about unity of effort in the cause. In this way it is thought possible to achieve some specific tangible results and supply the vital needs of industry in the coming year.

The work to be done in each co-operating centre should not be vague or indefinite but should, if possible, be set down specifically in a schedule. The names of leaders who take the responsibility for results in any centre for one year should be recognised and recorded. This is no time for prolonged discussions or controversies. Whatever can be attempted should be done quickly.

The Central Government may perhaps wish to start an organisation like the National Research Council, themselves. If they step in at any time to regulate those activities with popular support, their co-operation will secure vast advantages; and I am sure, the unofficial Committee will co-operate or instantly make room and unhesitatingly surrender its responsibilities to Government control.

INDIAN FARMING

THE immense amount of research work in Agriculture that has been in progress in India, though admittedly of a high order both from the scientific and from the practical standpoint, has suffered from the drawback that the results have not always reached the cultivator as speedily or as widely as they ought to have. As the extent to which such results reach the countryside and are adopted by the cultivator will form not only the best test of their value but also the justification of the expenditure of money on the work, the criticism assumes great importance and we are glad to note that recently the *Imperial Council of Agricultural Research* has been bestowing a great deal of attention on the ways and means of bridging this gap between the laboratory or the experimental farm and the cutlivator's field, in the most effective manner. One of the first fruits apparently of these endeavours is the Council's decision to replace the well-known journal, *Agriculture and Livestock in India* by a more popular agricultural magazine, which will moreover be issued once a month, unlike the former which was being issued once in two months. The opening number of this new magazine which is styled *Indian Farming* has just appeared and we gladly welcome the publication. Appropriately enough, His Excellency the Viceroy, Lord Linlithgow, contributes a message of good wishes to this further attempt in rural development—a matter which has always been nearest to his heart. We consider it was a wise decision to issue the journal as a monthly publication, so that matters of agricultural interest may be constantly brought before the public eye. The contents of the opening number are well chosen and the presentation leaves little to be desired. New features are also added notably a 'question and answer' section, which should greatly enhance its usefulness. We wish *Indian Farming* a long career of usefulness.

A. K. Y.

HIS HIGHNESS THE LATE YUVARAJA OF MYSORE

OBITUARY

HIS HIGHNESS SIR SRI KANTIRAVA NARASIMHARAJA WODEYAR BAHADUR, K.C.I.E., G.C.I.E., THE YUVARAJA OF MYSORE

A GREAT and charming Prince is dead. The loss to the Royal Family of Mysore is grievously irreparable, and to the people of the State, profoundly sorrowful. Born in June 1888, His Highness was only fifty-two years at the time he passed away, and what makes the sadness the most poignant, is, that the demise took place far away from his home, his family and his devoted people.

Some of the lineaments of the character of this Prince were early discernible in the child. Intelligent beyond his age and endowed with a healthy constitution, he distinguished himself in the Royal School by his industry and diligence, while no instinct of delicacy veiled his rompings. When still of a tender age, he had the misfortune to lose his father, H. H. the late Sri Chamarajendra Wodeyar, in 1894, and his education and training were entrusted to Mr. (now Sir) Stuart Fraser and Mr. P. Raghavendra Rao, under the immediate oversight of the late lamented Maharani. When H. H. the Maharaja was invested with ruling powers in 1902, it was decided to send the young Yuvaraja to the Mayo College at Ajmer, where unfortunately, his education was abruptly terminated owing to severe illness, but soon after he came under the care and influence of Captain Heale.

His Highness the Yuvaraja was a well-travelled man. Early in 1901 he accompanied his illustrious brother on an educational tour to Burma, and in 1908 paid a visit to that most fascinating State, Kashmir, at the end of which he sailed for Japan, though H. H. the Maharaja, for whom the programme was originally arranged, could not proceed owing to threatened famine in the State. His Highness accompanied his brother to attend the Imperial Coronation Durbar at Delhi in 1911,—a year after his wedding with the accomplished and cultured daughter of the late Sir Dalavai Devaraj Urs, one of the foremost noblemen of the State. In 1913 he went to Europe, where he visited practically all the important countries. H. H. the Yuvaraja early discovered that these visits were of such educational value, providing an immense mass of material for close and critical study, that he repeated them several times.

His Highness leaves behind him his great and lamenting brother, his sorrowing wife and a son and three daughters all deeply mourning at the sudden and grievous loss. In this hour of bereavement, we beg to tender to the Royal Family of Mysore our respectful condolences, and we pray that Providence will, in His tender mercy, support and comfort its members in their sorrow.

His Highness had remarkable administrative abilities which found early expression, while being trained in the Maharaja's Private Secretary's Office and later in the administration of Sir M. Visvesvaraya, when he acted as an Extraordinary Member of the State Executive Council. His Highness took a deep interest in all public movements. He was the First Chief Scout in the State, where, under his influence, scouting has become an important activity of all educational institutions. He lent the weight of his support to the cause of the social and political amelioration of the depressed communities in the State. The present prosperous condition of the co-operative movement owes largely to his inspiration and encouragement. There was hardly any organisation of public beneficence and utility, with which he was not personally or indirectly associated.

His gifts of intellect and character were only equalled by his eminent and lovable social qualities. Under the somewhat austere princely demeanour, he wore a sterling human heart. His talents were as varied as they were strong. The Prince was an excellent horseman, distinguished himself in all manly sports; was a polished public speaker; a great lover of books and a passionate patron of music of which he was no mean exponent.

Mysore has lost a lovable Prince, sagacious, generous and enlightened.

To H. H. the Maharaja and to Prince Jaya Chamaraja Wodeyar, we, along with their other subjects, beg to tender our respectful and heartfelt sympathies.

LETTERS TO THE EDITOR

2-N¹-Sulphanilamidothiazol in Plague Infection

Since the middle of last year, Mr. K. Ganapathi, a Lady Tata Memorial scholar, working at the Haffkine Institute, has been synthesizing derivatives, particularly heterocyclic derivatives, of sulphanilamide.[1,2,3] Of the 35 compounds synthesized by him, six have been so far tested for their effect on plague infection. One of them, 2-N¹-sulphanilamidothiazol, synthesized by him in collaboration with Dr. B. K. Nandi, has been found to be exceptionally valuable.

For testing the value of this compound in plague infection, we used the method which was developed by one of us (S. S. S.) for assaying the curative value of antiplague sera.[4] This method employs the Haffkine Institute-inbred white mouse as the experimental animal,[5] and an infective dose of about 100 organisms of a constant virulence[6,7] given subcutaneously. For each experiment 50 mice were used. These, after the induction of infection, were divided into five batches of 10 mice each. The administration of the drug was commenced at the same time as the infection in the first batch, 24 hours after infection in the second batch, 48 hours after infection in the third batch and 72 hours after infection in the fourth batch. The fifth batch was used as control. This division into batches was carried out with a view to test the efficacy of the drug at different intensities of the infection. An interval longer than 72 hours between the induction of infection and the commencement of exhibition of the drug cannot be employed as the infected animals begin to die from 72 hours onwards. The drug was given in quantities of 10 mg. twice a day to 40 mg. twice a day for 10 to 20 days per mouse.

In each case an emulsion of the drug was introduced into the stomach of the mouse with a specially made pipette. Each batch of animals under experiment was observed for a period of 35 days.

Four experiments carried out so far show that if the drug in sufficient quantities is given even fairly late in the infection a very large percentage of the mice infected are saved. In its curative action the drug is almost as good as a good antiplague serum and superior to sulphanilamidopyridine.

The results being so good in the mouse, which succumbs to plague infection much more readily than man, there is every expectation that when tried in human cases, as we hope to do soon, the drug will be found to be almost a specific for plague.

S. S. Sokhey.
B. B. Dikshit.

Haffkine Institute,
Bombay,
March 14, 1940.

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1 Ganapathi, K., *Ind. J. Med. Res.*, 1940 April issue (in press).

2 *Idem.*, *Proc. Ind. Acad. Sci.*, 1940 March issue (in press).

3 Ganapathi, K., and Nandi, B. K., *Curr. Sci.*, 1940, **9**, 67.

4 Sokhey, S. S., *Report of the Haffkine Institute* for the year 1938, p. 32.

5 *Idem.*, *Ind. J. Med. Res.*, 1939, **27**, 341.

6 *Idem.*, *ibid.*, 331.

7 *Idem.*, *ibid.*, 363.

Kostanecki Acylation of Orcacetophenone

With a view to prepare the hitherto unknown 7-hydroxy-4:5-dimethyl coumarin, which cannot be obtained by the Pechmann condensation of orcinol with ethylacetoacetate, which gives 5-hydroxy-4:7-dimethyl coumarin,[1] *p*-orsellinic acid (*a*) was condensed with ethylacetoacetate in presence of conc. H_2SO_4, when 7-hydroxy-4:5-dimethyl coumarin-8-carboxylic (*b*) acid was obtained. This was decarboxylated to the required 7-hydroxy-4:5-dimethyl coumarin (*c*). The coumarin structure has been inferred from its non-identity with 7-hydroxy-2:5-dimethyl-chromone synthesised by the condensation of orcacetophenone dimethyl-ether with ethyl-acetate and subsequent ring closure of the β-diketone formed. In this connection we thought of getting the same chromone by the Kostanecki acetylation of orcacetophenone.

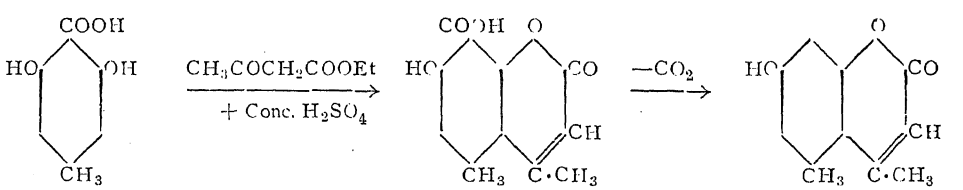
Orcacetophenone on heating with sodium acetate and acetic anhydride gave a product containing two acetyl groups to which the constitution of 7-acetoxy-4-acetomethyl-5-methyl coumarin (I) has been provisionally assigned. This on treatment with conc. H_2SO_4 gave 7-hydroxy-4-acetomethyl-5-methyl coumarin (II) which was deacetylated with sodium hydroxide to 7-hydroxy-4:5-dimethyl coumarin (III), identical with the decarboxylated product (c) from the *p*-orsellinic acid condensation described above. Both the products (I) and (II) gave 2:4-dinitrophenyl hydrazones. Product (III) gave fluorescence with alkali, but, the product (II) did not.

Orcacetophenone monomethyl ether gave on a similar acetylation the methyl ether of (II).

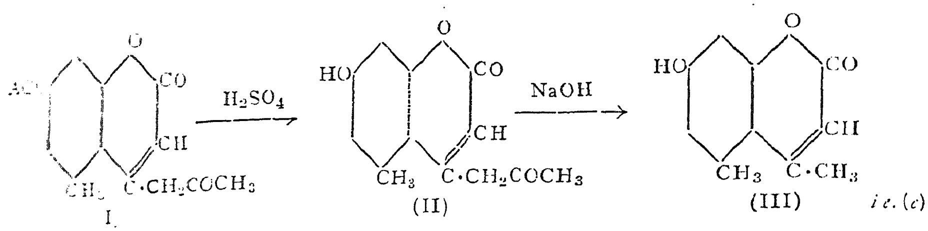
Orcacetophenone and its monomethylether gave on propionylation and butyrylation 4-substituted coumarin derivatives analogous to those described above.

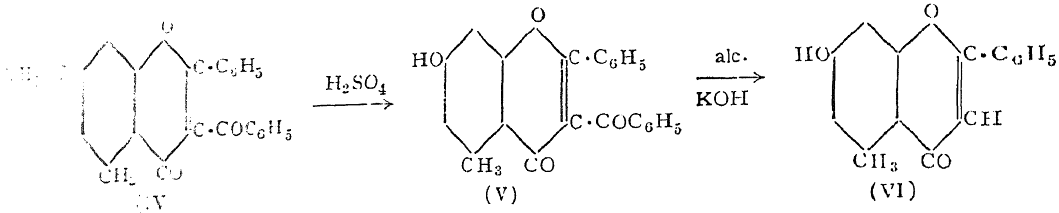
The exclusive formation of a coumarin in the Kostanecki acetylation of orcacetophenone shows that the 5-methyl group in the resorcinol nucleus has a profound influence on the course of the Kostanecki reaction, as resacetophenone gives on a similar acetylation a chromone.[2]

The formation of 4-acyl coumarins in the



(*a*) (*b*) (*c*)





Kostanecki acylation has been observed for the first time, though the formation of 3-acyl chromones has been frequently met with. A noteworthy point is the new technique used successfully for the stepwise elimination of o-acyl and c-acyl groups by the successive use of conc. H_2SO_4 and alkali. H_2SO_4 only removes the o-acyl group leaving the c-substituted group in the pyrone ring intact. This method appears to be of general applicability and can be also extended to the stepwise elimination of *o*-aroyl and c-aroyl groups in the case of flavones—for example—orcacetophenone and its monomethyl ether on benzoylation gave 7-benzoyloxy-3-benzoyl-5-methyl flavone (IV) which on treatment with conc. H_2SO_4 gave 7-hydroxy-3-benzoyl-5-methyl flavone (V). The latter on treatment with hot alcoholic KOH gave 7-hydroxy-5-methyl flavone (VI) of Tambor.[3]

The details will be shortly published elsewhere.

We are extending the application of this method to other cases of aroylation and acylation of o-hydroxy ketones.

SURESH M. SETHNA.
R. C. SHAH.

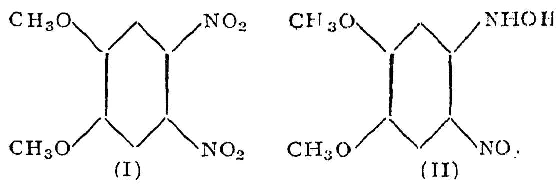
Elphinstone College, Bombay,
Royal Institute of Science,
Bombay,
January 31, 1940.

1. [illegible] and Chrystall, *J.C.S.*, 1907, **91**, 1804.
2. Kostanecki and Rozycki, *Ber.*, 1901, **34**, 102.
3. Tambor, [illegible], 1908, **41**, 796.

Reduction of Dinitro Veratrol with Sodium Sulphide

DINITRO VERATROL (I) is usually reduced to diamino veratrol by Stannous chloride and hydrochloric acid.[1] Whilst trying the reduction by means of sodium sulphide, it was found that under certain conditions nitro veratryl hydroxylamine (II) was formed besides forming a diamino veratrol. This is interesting from the point of view that a partial reduction of only one nitro group in dinitro veratrol can be effected with sodium sulphide. The exact conditions of reaction are as follows:

Dinitro veratrol in absolute alcohol was warmed to about 60° C. and added gradually while cooling (under the tap) and shaking to a warm saturated solution of sodium sulphide. On allowing to stand, a deep red coloured substance separates out. It is filtered, washed with a little absolute alcohol and crystallised from alcohol. This is the sodium salt of the hydroxylamine (m.p. 194° C.).



The sodium salt is extremely soluble in water and reduces ammoniacal silver nitrate solution. The free hydroxylamine can be liberated by acidifying the aqueous solution (to congo red paper). The free hydroxylamine is orange

brown in colour and crystallises in needles from methyl alcohol; m.p. 110° C.

(Analysis: $C_8H_{10}O_5N_2$ requires C, 44·86; H, 4·67; N, 13·08 per cent.; Found C, 45·02; H, 4·75; N, 12·96 per cent. $C_8H_9O_5N_2Na$ requires N, 11·86 per cent.; Found N, 11·64 per cent.)

B. K. NANDI.

Haffkine Institute,
Parel, Bombay,
February 12, 1940.

[1] Heinisch, M., *J.C.S.*, 1894, **15**, 234.

Sodium Oleate Gels in Pinene

SOAP solutions in aqueous medium have been exhaustively studied by McBain and co-workers.[1] They succeeded in bringing an aqueous solution of sodium oleate into any of the three typical colloidal states, namely, clear oily liquid sol, clear transparent elastic gel and white opaque solid curd at any temperature between 0° and 25°. They also established that soap sol and soap gel are identical in respect of (*i*) electrical conductivity, (*ii*) lowering of vapour pressure, (*iii*) refractive index and (*iv*) concentration of sodium ions but they differ from each other with regard to elasticity and rigidity which are the characteristics of the gel form alone.

Very little work seems to have been done on soap gels in non-aqueous medium. Fischer[2] found that sodium archidate forms a non-syneretic gel in ethyl alcohol. Miss Laing and McBain[3] found that potassium and sodium soaps crystallise in flakes from dry alcohol. On cooling jellies are formed only when sufficient water is present to bring the necessary amount into colloidal solution. Yajnik and co-workers (private communication) have obtained opaque gels by cooling a solution of sodium oleate in turpentine-water and alcohol-water mixtures.

The authors have found that when a mixture of sodium oleate and pinene is heated to 140° aproximately, a clear solution is obtained and this, on cooling, sets to a transparent gel. It has been found that the time of setting of these gels, determined by Flemming's method, decreases as the amount of sodium oleate in the gel is increased and increases with an increase in the temperature at which the gel-forming mixture is allowed to set. By the application of Arrhenius's equation (*cf.* Hurd and co-workers)[4] it has been found that the heat of activation for the setting process is a negative quantity.

The gels exhibit markedly the phenomenon of syneresis which starts not only from the exposed surface of the gel but also from the surface of contact of the gel with the container, so that the gel slips out of the container after some time. The amount of liquid exuded in a given time increases with a decrease in (*i*) the sodium oleate content of the gel and (*ii*) temperature. By the application of the relation

$$h^a = kt$$

(h is the height to which a liquid rises in strips of filter-paper in time t, and a and k are constants), it has been shown that syneresis in the case of these gels obeys the same laws as the imbibition of liquids (negative syneresis, *cf.* Hardy[5]).

A study of the refractive index of several gels set at the same temperature shows that it remains practically unchanged with a change in the sodium oleate content, but with a change in temperature of setting it decreases as the temperature of setting (temperature of measurement being the same as the temperature of setting) is increased, and the relation between the two is practically linear.

MATA PRASAD.
K. N. MATHUR.

Chemical Laboratories,
Royal Institute of Science,
Bombay,
February 14, 1940.

[1] *J.C.S.*, 1920, **117**, 1506; *Proc. Roy. Soc.*, 1921, **98A**, 395.
[2] *Chem. Eng.*, 1919, **27**, 184.
[3] *Koll. Zeit.*, 1924, **35**, 29.
[4] *J. Phys. Chem.*, 1932, **36**, 604.
[5] *Proc. Roy. Soc.*, 1926, **112**, 47.

Formation of Uro-lac

It was suggested[1] that the optical activity of lac is a useful property which could be of considerable value in investigating the reaction of ureas and other substances with lac, which is widely practised with a view to improve the quality of lac in certain directions. Treatment of lac (*Kusum* bleached) in butyl alcohol with urea (10 per cent. on the weight of lac), in presence of anhydrous sodium sulphate and refluxing the reaction mixture at the temperature of boiling water for 24 hours, results in the formation of uro-lac, lac in which urea exists in the combined state. The free and uncombined urea in the reaction mixture is eliminated by repeatedly washing the butyl alcohol solution with water until a portion of the washings does not show any trace of urea as determined by the urease test.

A control experiment without urea was also conducted. Similar sets of experiments were carried out with sclero- and soft-lacs both of which were prepared from *Kusum* bleached lac. The following table gives the figures for the acid value, specific rotation and the total nitrogen of the resulting products:

	Acid value	Specific rotation $[\alpha]_D^{25°C.}$	Total nitrogen %
Lac ..	63·81	54·34	0·05
Lac-*uro* ..	57·94	60·06	1·30
Sclero-lac ..	52·82	47·96	0·00
,, *uro* ..	49·94	47·55	1·12
Soft-lac ..	82·39	49·19	0·00
,, *uro* ..	78·50	51·28	1·32

A decrease in acidity accompanies treatment of lac or its components with urea, while a definite increase in optical activity is registered with urea compounds of lac and its soft component. Treatment of sclero-lac with urea does not appear to bring about any change in its optical activity, although it has entered into combination with about the same quantity of urea. It has been found that under the conditions of the experiment, about 2·8 per cent. of urea can be made to react with lac and its components.

P. S. Sarma.
M. Sreenivasaya.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
March 18, 1940.

[1] *Curr. Sci.*, 1939, **8**, 165.

Detection of Adulteration in 'Ghee' (Clarified Butter) by the Ultra-Violet Fluorescence Technique

It has long been known that many substances show a fluorescence under ultra-violet light and this property of the ultra-violet light has of late been increasingly utilised in the detection of adulteration in certain drugs, *e.g.*, alkaloids, cod liver oil.[1,2] While engaged in the analyses of cod liver oil in the laboratory, one of us (M.C.M.),* who had considerable experience in the analysis of food materials like butter and 'ghee' at the Sind Government Laboratory at Karachi, suggested that the fluorescence technique could be extended to the field of 'ghee' analysis.

(1) To start with, about 20 to 25 samples of 'ghee' from various sources were purchased from the local market. These were all melted at a low temperature and were exposed simultaneously under the ultra-violet fluorescence lamp (Hanovia-Muir type). A number of common adulterants of 'ghee' such as groundnut oil, cocoanut oil, cotton seed oil, hydrogenated oil (*Dalda vanaspati*), gingelly oil, lard, margarine, tallow, etc., were secured and treated in

* Officer attached to the Chemico-Bacteriological Laboratory, Karachi, on deputation for training at the Biochemical Standardisation Laboratory, Government of India.

the same manner under the ultra-violet lamp, the distance from the ultra-violet ray tube and the time of exposure remaining constant in both cases. The results are indicated in the following table:

TABLE I

No.	Article	Nature of flourescence	Remarks
1	Cow ghee	Deep green	Slight difference in shade
2	Buffalo ghee	,,	,,
3	Groundnut oil	Bright blue	Shades slightly different from each other
4	'Dalda vanaspati'	,,	,,
5	Cocoanut oil	,,	,,
6	Cotton seed oil	,,	,,
7	Gingelly oil	,,	,,
8	Lard	Strong blue	,,
9	Margarine	,,	
10	Beef tallow	Light blue	
11	Mutton tallow	,,	

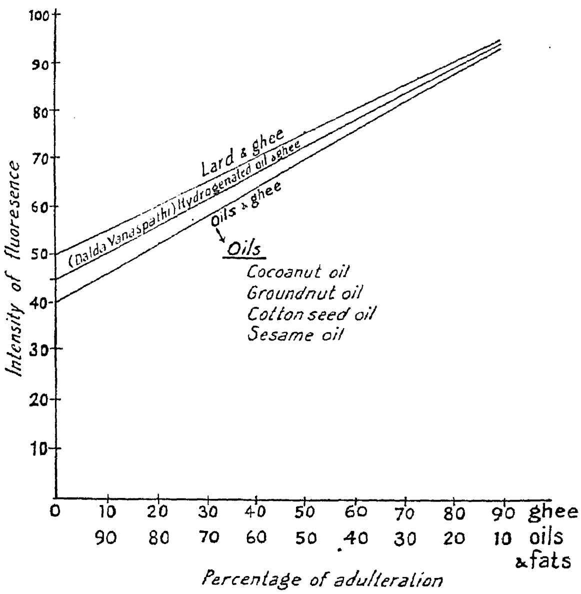
It will be noticed from the above observations that 'ghee', both from cow and buffalo milk, yielded a deep bright green fluorescence which was quite characteristic and differed significantly from the colour and intensity of the fluorescence emitted by all the common adulterants of 'ghee'. This observation naturally indicated that if genuine 'ghee' was mixed with varying proportions of the above adulterants, the resulting adulterated product would be characterised by a mixed green-blue fluorescence, in contra-distinction to the deep bright green of the pure 'ghee'.

(2) To determine to what extent the nature and degree of adulteration could be correlated with the intermediate shades of fluorescence between the green on the one end and the blue on the other, a quantity of 'ghee' was prepared† from a sample of genuine and certified butter obtained from a local dairy firm and this was mixed with the different adulterants in proportions varying from 10 per cent. to 90 per cent. and exposed to ultra-violet light under the Hanovia-Muir Lamp in the same manner as described in (1) above. It was noticed that an adulteration extending from 20 per cent. upwards could be easily recognised by the naked eye by watching the gradual preponderance of the blue shade over the characteristic bright green of pure ghee. The difference in the nature and degree of fluorescence in the cases in which the adulterants occurred in proportions of less than 20 per cent., however, was not sufficiently marked to enable any definite opinion to be given. Further, it was realised that this method could only be used as a rough qualitative 'spot-test' for the detection of adulteration of 'ghee' in general, and that this method would not lend itself to accurate quantitative measurement unless the intensity of fluorescence could be measured and expressed in numerical terms.

(3) An attempt was therefore made to measure the fluorescence intensity and to establish a relation between the intensity of fluorescence and the degree of adulteration of genuine 'ghee'. The Pulfrich Photometer with

† The butter was divided into two portions—the first half was turned into ghee at a low temperature while the other half was exposed to a temperature over 100° C. Both samples gave fluorescence (Green) of equal intensity. On chemical analysis the samples gave the following results: B. R. value—42·5; Polenski value—2·2; R. W. value—31·6, indicating that it was genuine ghee.

the attached Analytical Quartz Lamp assembly, was used for this purpose and was found to be of particular advantage in investigating fluorescence phenomena. The samples of pure 'ghee' and the adulterated mixture dissolved in chloroform‡ were placed in 5 mm. glass cell in immediate proximity to the light source employed to excite the fluorescence (*e.g.*, Analytical Quartz Lamp). The fluorescence emitted by the ultra-violet light falling on the samples was then measured by interposing in the light path a red colour filter (L. 1). This filter was found after repeated trials to be the most suitable for our purpose. In the accompanying graph,|| the values obtained for the fluorescence intensity



are plotted against the different concentrations of the adulterated mixtures of ghee with vegetable oils, 'Vanaspati', lard, etc.

From a reference to the graph, it will appear that the intensity of fluorescence is more or less directly proportional to the degree of adulteration and that even minor degrees of adulteration up to 10 per cent. or perhaps to a lesser degree can be recognised by this method. This measure of fluorescence intensity can therefore be employed as a reliable guide in estimating the amount and perhaps the nature of the adulterant. If this technique can be perfected, it will place in the hands of the analysts a method which is not only easy and rapid but is likely to give a much more accurate and reliable information regarding adulteration of ghee and may obviate all the laborious chemical procedures now employed in the detection of adulteration in 'ghee', which is by far the commonest article found adulterated in the Indian dietary.

We wish to acknowledge our indebtedness to Colonel R. N. Chopra, C.I.E., I.M.S. (R.), for placing before us all facilities for work and to Prof. G. Sankaran and to Mr. P. K. Seshan for the use of the ultra-violet ray-Pulfrich Photometer assembly.

M. C. MUTHANNA.
B. MUKERJI.
Biochemical Standardisation Laboratory,
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March 5, 1940.

‡ The samples were originally liquefied at 40° C. before putting into the glass cells. As there was a tendency to solidification of the 'ghee' during experiments, a solution in chloroform, which was found to be non-fluorescent, was employed.

|| For convenience of presentation, the actual readings are not plotted but the points are joined to form a smooth line.

1 Common, R. H. (1937): *Analyst*, Vol. XXII, p. 784.
2 Iyengar, N. K. and Mukerji, B., *Ind. Med. Gaz.*, Vol. LXXIV, p. 215.

Calcium Utilisation from Green Leafy Vegetables

It is well known that rice is deficient in calcium. Of the many rice varieties (mostly South-Indian) investigated in this laboratory, the maximum calcium content was about 20–25 mg. per cent. Rau and Ranganathan[1] have shown that the quantity of calcium obtained from a rice diet is not more than 0·1 to 0·15 gm. per day while the daily requirement of an adult (according to Sherman) is 0·5 to 0·6 gm. The present investigation was taken up with a view to find how far the green leafy vegetables (which are rich sources of calcium) would supplement a low calcium rice diet.

TABLE I

Name of green	Calcium mgs. %	Anhydrous oxalic acid mgs. %	*In vitro* digestibility % calcium solubilised[7]
Amaranthus gangeticus	2750	9590	34
Amaranthus inamœnus	2947	9023	20
Amaranthus mangostanous	2453	8580	13
Atriplex hortensis	1083	12200	17
Sesbania grandiflora	3231	412	92
Trigonella fœnum græcum	1156	Trace	..
Hibiscus sabdriffa (ordinary variety)	1869	2145	71
Hibiscus sabdriffa (sour variety)	1521	1521	80
Leucerne	2161	Trace	..
Spinach from Bangalore—			
(1)	1515	12880	12
(2)	818	11190	13
(3)	969	10830	26

It has been shown by a number of American workers,[2–6] that the calcium of greens rich in oxalic acid is not available to the system due to the fact that calciumoxalate is the least available of all calcium salts.

The calcium, anhydrous oxalic acid and the amount of calcium solubilised by *in vitro* digestion with pepsin-HCl of the commonly used South-Indian greens are given in Table I.

It will be seen from the above table that most of the greens are associated with large quantities of oxalic acid and the amount of calcium solubilised by pepsin-HCl is generally low when the oxalic acid content is high and *vice-versa*.

In accordance with the observation of Mary Spiers,[8] the results obtained also show that the calcium of greens rich in oxalic acid is unavailable and that the oxalic acid renders some of the usually available calcium of skim milk also unavailable. Addition of 8 per cent. Co. 9 raw rice to such a diet prevents the skim milk calcium being rendered unavailable by the oxalic acid present in the green (Table II).

TABLE II

Diets	Number of rats	Average calcium availability %
(1) Skim milk (22 parts) (control)	4	92
(2) 11 Parts skim milk + a quantity of green (*Amaranthus gangeticus*) which contains the same quantity of Ca as is present in 11 parts of skim milk	4	35
(3) Diet (2) + 8% Co. 9 raw rice instead of starch ..	3	47

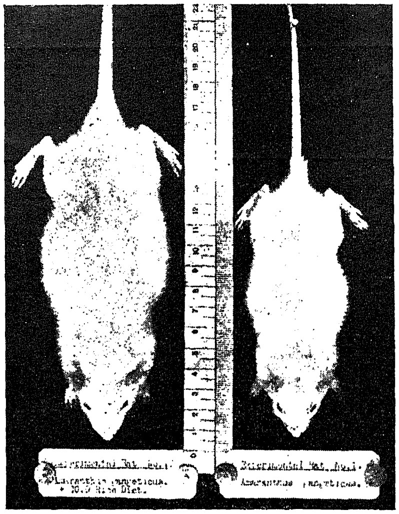
Sesbania grandiflora which contains very little oxalic acid (412 mg. per cent.) has a calcium availability (metabolic method) of 74 per cent. even at a very high level of calcium intake.

Preliminary experiments on the growth of rats with diets (suitable modification of Kon's[9]), *viz.*, (1) Co. 9 raw rice, (2) *Amaranthus gangeticus* and (3) *Amaranthus gangeticus* + Co. 9 raw rice, were carried out. In the course

of 7 weeks, 3 out of 6 rats on diet (1) died while the average weekly increase of a rat on diets (2) and (3) was 4 and 10 gm. respectively.

Quantitative experiments (Fincke and Sherman's[2] technique) with (1) *Amaranthus gangeticus* and (2) *Amaranthus gangeticus* + Co. 9 raw rice diets* were carried out. It was found that at the end of an experimental period of 32 days, 2 rats out of 3 on diet (1) died, the other rat had practically no retention of calcium while the rats on diet (2) had an average retention of 12 per cent. calcium even at a high level of calcium intake. The increase in the net body weight (whole rat *minus* gastro-intestinal contents) of the surviving rat on diet (1) was only 10 gm. while the average increase of the rats on diet (2) was 54 gm. The photograph shows the diifference of growths of the rats on the two diets.

The results clearly demonstrate that the oxalic acid present in *Amaranthus gangeticus* not only renders all its calcium unavailable but also decreases the availability of skim milk calcium. The inclusion of raw rice (Co. 9) in the *Amaranthus gangeticus* diet renders part of



the skim milk calcium available. Further work to explain the above observation is in progress.

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February 13, 1940.

* Composition of diets

Ingredients	(1) *Amaranthus gangeticus*†	(2) *Amaranthus gangeticus* + Co. 9 raw rice
Egg white	15	15
Salt mixture[10] (Ca.P. free)	3	3
Butter	5	5
Amaranthus gangeticus ..	15	15
Co. 9 raw rice	..	62
Corn flour	62	..
Calcium mgms.% ..	436	422
Phosphorus mgms.% ..	223	279

† 0·78 g. NaH_2PO_4 was added to 100 gm. of diet.

1 Rau and Ranganathan, *Zeit. f. physiol. Chem.*, 1939, **258**, 137.
2 Fincke and Sherman, *J. Biol. Chem.*, 1935, **110**, 421.
3 McClugage and Mendel, *Ibid.*, 1918, **35**, 353.
4 Sherman and Hawley, *Ibid.*, 1922, **53**, 375.
5 Fairbanks and Mitchell, *J. Nutrition*, 1938, **16**, 79.
6 Tisdall and Drake, *Ibid.*, 1938, **16**, 613.
7 Horwitt, Cowgill and Mendel, *Ibid.*, 1936, **12**, 237.
8 Mary Spiers, *Ibid.*, 1939, **17**, 557.
9 Kon, *Milk and Nutrition*, Part I, 1937, 12.
10 Avellar De doureiro, *Arch. patol. Lisboa*, 1931, **3**, 72.

On the Occurrence of the Foraminiferal Genus *Orbitocyclina* in the Cretaceous Rocks of the Trichinopoly District, S. India

Our knowledge of the Orbitoidal foraminifera from the Cretaceous rocks of the Trichinopoly District is confined to a single species, *Lepidorbitoides minor*,[1] described from a collection made by H. F. Blanford (1858) from near Niniyur and Chokanadapuram. In the course of

a recent examination of orbitoids collected from the Upper Cretaceous beds about two miles south of Chokanadapuram, I have noticed besides *Lepidorbitoides*, the occurrence of a form assignable to the genus *Orbitocyclina* (Figs. 1–3). This genus was created recently by Vaughan[2] for *Lepidorbitoides minima* H. Douville (= *Polylepidina cardenasensis* Galloway, 1928) and has been shown by him to be an intermediate form between the Cretaceous *Lepidorbitoides* and the Tertiary *Polylepidina*. The

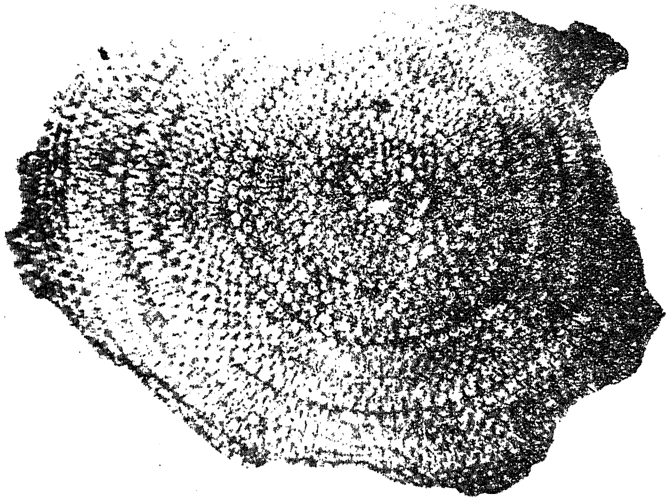

FIG. 1

Equatorial section of *Orbitocyclina* sp. (A-form). × 25. Loc.—2 miles south of Chokanadapuram.

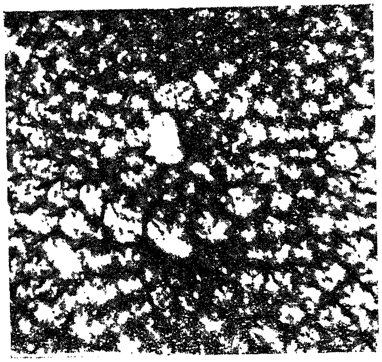

FIG. 2

Part of Fig. 1 enlarged to show the embryonic apparatus of the *Lepidorbitoides*-type followed by 12 peri-embryonic chambers arranged in a spiral. × 60.

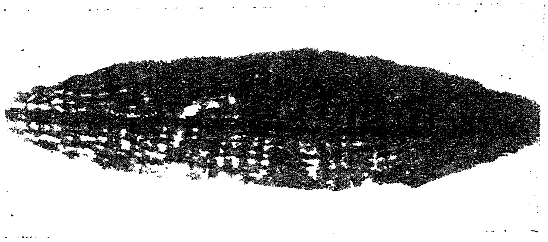

FIG. 3

Meridian section of *Orbitocyclina* sp. to show the absence of pillars. × 25. Loc.—same as above.

validity of the new genus *Orbitocyclina* has, however, been recently questioned[3, 4] and it has been suggested that it is only a synonym of *Lepidorbitoides*. Since the initial spiral of the equatorial chambers noticed in the new genus does not occur in *Lepidorbitoides* (*S.S.*), it would be necessary to distinguish the two forms by retaining the name *Orbitocyclina*, at least, as a

FIG. 4

Equatorial section of *Lepidorbitoides* sp. The stolon-passages and chambers appear dark due to the presence of infiltrated ferruginous material. × 90. Loc.—same as above.

sub-genus. According to Vaughan,[5] *Orbitocyclina* is so far known only from the Cretaceous beds of America, and the present find is interesting as extending its geographical range to South India also.

It may also be pointed out that all the Trichinopoly orbitoids exhibit clearly the stolon-passages between the equatorial chambers due to the infiltration of some ferruginous material (Fig. 4): and it is interesting to note that Stoliczka had observed these passages in the South Indian material as well as in specimens of *Lepidorbitoides* from the type area in Maëstricht (Holland), so far back as 1873.

A full account of the Orbitoidal foraminifera in my collection will be published elsewhere.

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March 10, 1940.

[1] Originally described as *O. Faujasi* by Stoliczka (*Pal. Ind.*, 1872–73, Ser. 8, 4, 61–62), and later as *O. minor* by Vredenburg (*Rec. Geol. Surv. Ind.*, 1908, **36**, 205). Vredenburg's identification was, however, questioned by Douvillé (*Pal. Ind.*, n.s., 1916, **5**, mem. 3, 34) who included it in his synonym of *L. socialis*.

[2] Vaughan, T. W., *Proc. Nat. Akad. Sci.*, Washington, 1929, **15**, 291.

[3] Rutten, M. G., *Proc. K. Acad. Wetensch.*, Amsterdam, 1925, **28**, 186.

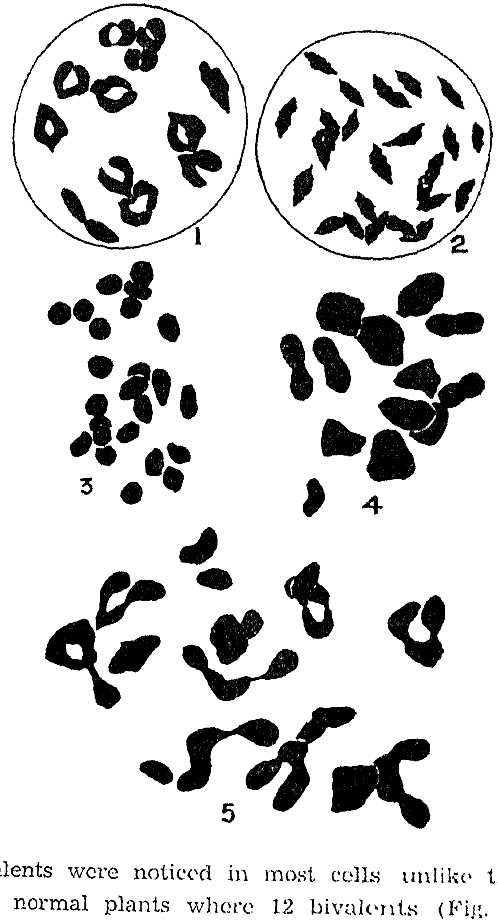
[4] Thiadens, A. A., *Jour. Pal.*, 1937, **11**, 99.

[5] Vaughan, T. W., *Proc. Nat. Acad. Sci.*, Washington, 1933, **19**, 925.

Asynapsis in Chilli (*Capsicum annuum* L.)

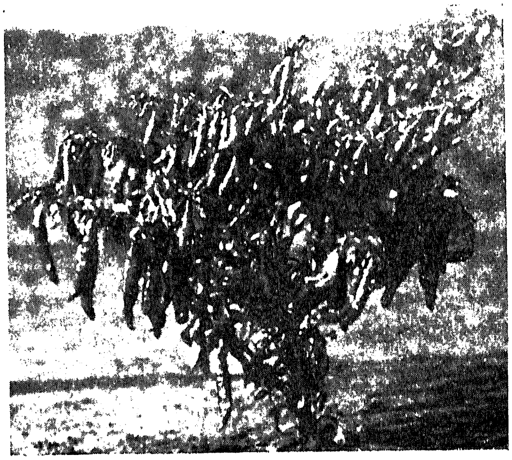
ASYNAPSIS is a meotic abnormality in individuals—both animals and plants—in which no chromosome pairing takes place at diakinesis and metaphase I. Plants showing this phenomenon have been described such as maize, wheat, oats, rice, *Datura, Nicotiana, Oenothera* and *Pisum*. Asynapsis in plants may be induced by external agencies like temperature, X-rays, chemicals, etc., or may be genotypically controlled. In some of the abovementioned species the occurrence of asynaptic plants has been traced to the presence of recessive genes.

During the year 1938–39, in a population of chilli plants raised from seeds obtained from a seed-store, one plant was noticed to be highly sterile; it formed only a few ill-developed pods with only two or three seeds in each, in spite of profuse flowering. Its pollen was found to be nearly 90 per cent. sterile. A cytological examination of pollen meiosis of this plant was undertaken. At diakinesis (Fig. 1) 24 uni-

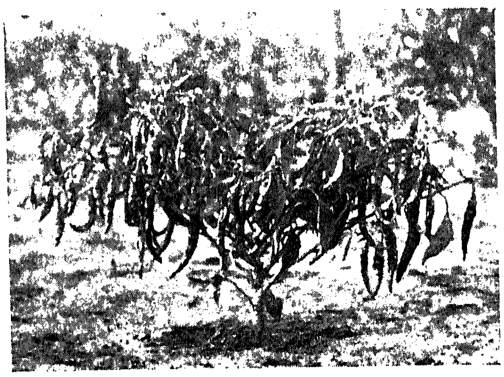


valents were noticed in most cells unlike that in normal plants where 12 bivalents (Fig. 2) were invariably found. Occasionally, however, a bivalent could be seen in some cells, loosely paired at one end only. The metaphase congression was absent in the cells of the sterile plant and the anaphase (Fig. 3) set in with unequal and irregular distribution of univalents to the poles. The first division as a

6. Diploid



7. Trisomic



8. Trisomic

9. Triploid

consequence was very irregular. Some cells, however, showed restitution nuclei in them at this stage. The second division was more regular but many of the pollen grains degenerated soon after meioses.

The few seeds set on this plant by open pollination were sown during 1939–40 and ten plants were raised to maturity. Of these, two plants were found to be triploids, two trisomics, and six diploids. Pairing of chromosomes at meiosis was normal in the diploids which showed normal fruiting and setting of seeds. The triploid plants, one of which is shown in Fig. 9, were larger in size than the diploids (Fig. 6) and had about 80 per cent. sterile pollen. Fruiting was scarce although the plants continued to flower over a longer period than the diploids, and seed-setting was limited to a few in each pod. Pollen meiosis in the triploids showed varying numbers of trivalents, bivalents and univalents at diakinesis. Fig. 5 shows a diakinesis with $9^{III} + 3^{II} + 3^{I}$. The two trisomics each with $2n = 25$ chromosomes had 30–40 per cent. sterile pollen but formed a good number of fruits with seeds. They differed, however, in their habit; one trisomic (Fig. 7) had thick foliage, clustered flowers and produced fruits in clusters while the other (Fig. 8) was dwarfed, with spreading branches and flowers borne singly in the axils of leaves. It is believed that they are two different primary trisomics each containing a different chromosome of the haploid set as an extra in it. An attempt will be made to obtain the other ten primary

trisomics. In the trisomics, at division I, the extra chromosome was found to lie outside the metaphase plate, as a univalent (Fig. 4) or was found paired with its homologues forming a trivalent.

The progenies of all these plants will be studied during the next season and a fuller report of the work will be published elsewhere.

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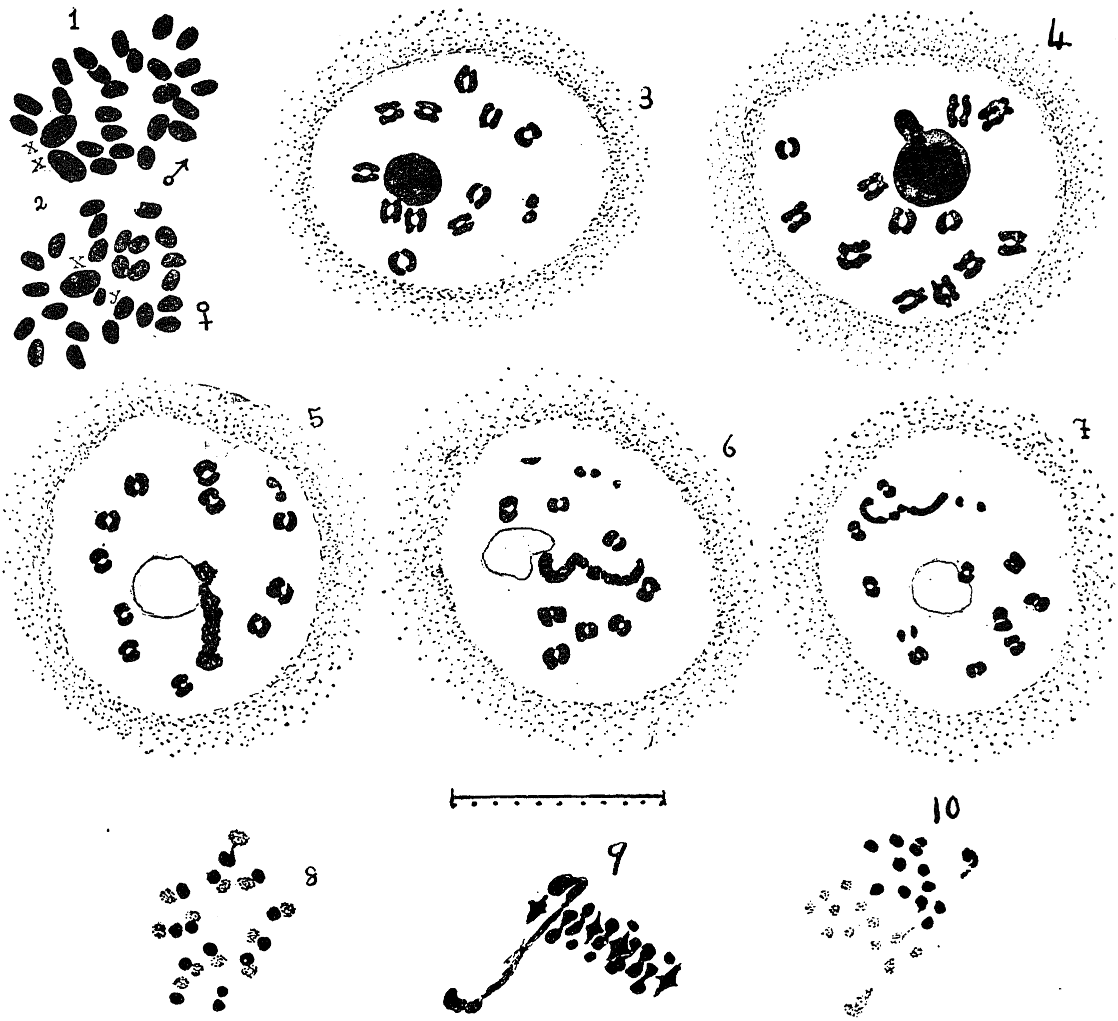
February 10, 1940.

Sex Chromosomes of *Coccinia indica* Wight and Arn.

Coccinia indica Wight and Arn. is a diœcious species belonging to the Natural Order Cucurbitaceæ. Chromosome numbers of *C. hirtella* ($2n = 24$) and *C. indica* ($n = 12$) have been determined by McKay[1] and Sutaria[2] respectively. In a detailed study of the behaviour of chromosomes during mitosis and meiosis of normal and parthenogenetically developed male and female plants of *C. indica* the authors have observed that thirteen chromosomes in the gametic and twenty-six in the somatic tissues are most frequently met with. Of the twenty-six chromosomes in the female, twelve pairs were of uniform size and the thirteenth was heteromorphic in that one chromosome of the pair was bigger and the other smaller than any of the remaining chromosomes of the complement (Fig. 2). Similarly in the male, twelve pairs were of uniform size and equalled in size the corresponding pairs in the female. The thirteenth pair in the male was homomorphic and consisted of two large chromosomes, which were as large as the large chromosome in the heteromorphic pair of the female (Fig. 1). It was also observed that the largest and smallest chromosome in the female and the two largest ones in the male show somatic association during mitosis (Figs. 1 and 2). The heteromorphic pair (XY) of the female and homomorphic pair (XX) of the male constitute the sex chromosomes of *Coccinia indica*. This observation was further confirmed by the behaviour of the sex chromosomes during a study of meiosis in microsporogenous tissue.

The chief feature in the development of sex chromosomes during meiosis in *C. indica* is the delay in their origin. They do not appear until the autosomes have undergone considerable longitudinal contraction and have reached the late diplotene stage. Fig. 3 shows the twelve bivalents at diakinesis stage with the pair of sex chromosomes not yet formed. At about this stage from the persistent nucleolus an outgrowth arises which later extends out to form a coiled structure (Figs. 4 and 5). Still later this detaches itself to form the homomorphic pair of sex chromosomes each with a secondary terminal constriction (Fig. 6). From his study of the behaviour of nucleolus Mensinkai[3] concludes that there is an exchange of material between nucleolus and chromosome. Gates[4] in his review of the association of the nucleolus with Sat-chromosomes and chromosomes with secondary terminal constriction brings out the fact that these chromosomes are responsible for the organization of the nucleolus at telophase. The method of formation of sex chromosomes as observed in *C. indica* during prophase appears to show the reverse process of what happens at telophase in other cases. In telophase the chromosome organize the nucleolus and in prophase nucleolus organizes the chromosome from which it had previously arisen.

During microsporogenesis the sex chromosomes of *C. indica* are further characterized by their end association due to the presence of a single terminal chiasma in the shorter arm (Figs. 6 and 7). There is a differential condensation of the longer and the shorter arms and the longer arm shows negative heteropycnosis (Figs. 6 and 7). The non-pairing of the longer arm, differential staining, negative heteropycnosis and complete absence of chiasmata appear to indicate that the longer arm represents a genetically inert region. This inference is also strengthened by the observation of end association between the short arms only. At



metaphase the sex pair invariably orientates itself along the edge of the equatorial plate as in sex chromosomes of rat (Koller and Darlington[5]).

During anaphase the sex chromosome pair shows precocious separation (Figs. 9 and 10) due to the presence of a single terminal chiasma on it and the twelve autosomal pairs having two interstitial chiasmata each, separate subsequently (Figs. 3 and 9). Anaphasic separation of the sex chromosome pair shows a chromatid bridge between the genetically active short arms (Fig. 9). Precocious separation and bridge formation as observed in *C. indica* also appear to be a common feature of the sex chromosomes of the diœcious species in both dicotyledons and monocotyledons studied by Sinoto.[6] Occurrence of such a chromatid bridge in the sex chromosomes and their precocious separation, according to Darlington, is better explained due to genetic effect than due to inversion.

Association of sex chromosomes with nucleolus has been observed in insects and in Hepatacæ among the Cryptogam. In Figs. 4–6 the association of sex chromosomes with nucleoli is clearly evident. Such a type of association among higher flowering plants has so far not been reported and the present instance in *C. indica*, therefore, appears to be the first of its kind.

Heterogametic (XY) condition of the female, such as it exists in *C. indica*, is very rare in plants. It has so far been observed in *Fragaria elatior* by Lilienfeld.[7] In *C. indica* parthenogenetically developed plants in which the male element has been completely excluded have been observed to segregate into male and female individuals during three successive parthenogenetic generations, showing that it is the female which is heterogametic. This is corroborated by the heteromorphic (XY) pair of chromosomes observed during mitosis in cells of the root tip of the female plants. This inference of heterogametic condition of the female is further confirmed by the statistical analysis of the size variation of the pollen grains. Frequency distribution of the pollen-size variation gives a sharp unimodal curve indicating the homogametic condition of the male. In those cases where male is heterogametic such curve is bimodal (Greguss Pal[8]).

From cytological study, segregation of parthenogenetic progenies and pollen analysis, it is clearly evident that the female of *C. indica* is heterogametic and the male homogametic.

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February 3, 1940.

1 McKay, J. W., *Bot. Gaz.*, 1930, 89, 416.
2 Sutaria, R. N., *Jour. Univ. Bombay*, 1936, 4, 21.
3 Mensinkai, S. W., *Ann. of Bot., N.S.*, 1939, 3, 763.
4 Gates, R. R., *Nature*, 1939, 144, 794.
5 Koller, P. C., and Darlington, C. D., *J. Genet.*, 1934, 29, 159.
6 Yosito Sinoto, *Proc. Imp. Acad. Tokyo* (Japan), 1928, 4, 175.
7 Lilienfeld, J. A., *Japanese Jour. Bot.*, 1936, 8, 119.
8 Greguss Pal, *Mathematische Nature. Aug. Ungarischen Academy*. Budapest (Hungary), 1927, 44, 378.

Macadamia ternifolia F. Muell., the Queensland Nut

The writer published an account of floral anatomy and embryology in *Macadamia ternifolia* F. Muell. some two years ago[1] and subsequently some further observations about the floral vascular structure were made in the same plant. These necessitated the publication of a second paper as a supplementary contribution to the subject. After the final preparation of this for the press (the paper has now appeared in the January issue of *Current Science*, 1940),[2] the writer came across a paper by Hartung and Storey[3] on "The Development of the Fruit of *Macadamia ternifolia*" in a recent number of the *Journal of Agricultural Research*. Evidently, these authors have not had any access to the first paper by the writer on *Macadamia*,[1] for they make no reference to it which contains a description of many interesting features in the development of the ovule.

Hartung and Storey[3] describe the development of the integuments of the ovule and point out at great length that in the formation of a hard shell in the mature seed it is only the outer integument that takes part, thus contradicting the earlier opinion of Francis[4] who regarded the shell as a combined testa and tegmen. In this connection it must be noted that the present writer had already stated in his first paper on *Macadamia*[1] that the shell is "formed by the outer integument" and that "within this hard coat are the thin and crushed inner integument, a few surviving layers of the peripheral portions of the nucellus and the remnants of the endosperm". He had further remarked that "all these are pressed firmly together and fusing with"—better, clinging to—"the outer hard coat of the seed, form a smooth and shining internal lining for the outer integument." Hartung and Storey[3] further discuss the nature of the fruit and remark that during their study "considerable doubt arose as to the accuracy of the generally accepted classification of the fruit as a drupe and of the shell of the nut as an endocarp or putamen". They call attention to the statement by Francis[4] that "A considerable amount of confusion exists in the descriptions of the fruit in systematic, botanical literature" and state that "He advances evidence in support of the fact that the nut is truly a seed and the fruit in which it is contained is not a drupe but a follicle." It is thus clear that the term *nut* may only be retained for common usage and for the purposes

of trade, the true nature of the fruit having been long ago pointed out by Francis.[4]

There are several other features in *Macadamia ternifolia* which are met with in the developing seed following fertilization (*cf.* Kausik[1]) and the reader will have to look in vain for an allusion to any of these in the paper by Hartung and Storey.[3] The chalazal region of the ovule contains a meristematic region, which can be detected even in young stages, and on account of the activity of this region, especially after fertilization, several layers of additional cells constituting an extensive nutritive tissue arise at the base of the ovule. This tissue is next invaded by the lower end of the embryo-sac which forms a number of processes containing a few free endosperm nuclei. The cellular portion of the endosperm is restricted only to the upper half of the embryo-sac.

A chalazal meristematic region has been recorded in the literature of the Proteaceæ in a few other members also, as *Protea lepidocarpon* (Ballantine[5]), *Grevillea robusta* (Brough,[6] Kausik[7]), and more recently in *G. Banksii* (Kausik[8]). Further, the writer has pointed out the formation of a remarkably worm-like structure, discovered for the first time and designated the *Vermiform appendage* of the endosperm, which invades the chalazal nutritive tissue in the developing seed of *Grevillea robusta* and *G. Banksii.* A similar structure has also been seen in *G. hilliana* and it is probable that it is a constant feature in the genus *Grevillea.*

In so far as Hartung and Storey[3] have not referred to any of the above interesting features already described in *Macadamia ternifolia* and in the other investigated members of the Proteaceæ, it must be remarked that their paper, which otherwise forms a welcome addition to the meagre literature of the family, falls short of being complete, even though the contention of the authors be that their interest lay chiefly in discussing the nature of the fruit in the Queensland nut.

With regard to the floral vascular structure in *Macadamia ternifolia* the writer has to say that he has very recently published a detailed account of it (Kausik[2]) in which he has also fully discussed the nature of the perianth and that his observations agree with the rather too brief account given by Hartung and Storey.[3] One interesting point (not mentioned by Hartung and Storey) is that in the formation of the vascular supplies to the perianth segments the midrib strand shows a distinctly double origin at the time of separating from the receptacular stele. Finally, it may be mentioned here incidentally that the writer has also now completed a study of the vascular anatomy of the flower in *Grevillea robusta,* the results of which are set forth in a separate paper to be published elsewhere. In this paper it has been shown that the staminal trace arises in the form of a pair of strands towards the inside of the midrib strand of the perianth and that the two members of the pair are seen distinctly separated from each other not only at the base of the flower but also for some considerable distance higher up in the perianth, fusing only below the level at which the anthers are no longer adnate to the floral envelope. This feature has been discussed in the light of the origin of the stamen from a branch-system as proposed by Wilson.[9]

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February 6, 1940.

1 Kausik, S. B., *Proc. Ind. Acad. Sci.*, 1938, **8**, 45.

2 —, *Curr. Sci.*, 1940, **9**, 22.

3 Hartung, M. E., and Storey, W. B., *J. Agric. Res.*, 1939, **59**, 39.

4 Francis, W. D., *Proc. Roy. Soc. Queensland*, 1928, **39**, 43.

5 Ballantine, A. J., *Ann. Bot.*, 1909, **23**, 161.

6 Brough, P., *Proc. Linn. Soc. N.S.W.*, 1933, **58**, 33.

7 Kausik, S. B., *Ann. Bot.*, N.S., 1938, **2**, 899.

8 —, *Ibid.*, 1939, **3**, 812.

9 Wilson, C. L., *Amer. J. Bot.*, 1937, **24**, 686.

Vegetative Sports in the Bamboo (*Bambusa arundinacea* Willd.)

VEGETATIVE sports in the sugarcane are well known. Striped sugarcanes occasionally show unicoloured ones which on vegetative propogation maintain this character and *vice-versa.*

There would appear to exist, however, no record of similar sporting in the bamboo. This photograph of a clump of *Bambusa arundinacea,* showing a striped sport might, therefore, be of some interest. The avenue which was originally planted from buds obtained from the nearby forests is over 27 years old, and about half a dozen, out of a total of fifty clumps, are showing this phenomenon. These sports show marked golden yellow or brown stripes on a

green background; the stripes vary in width and depth of colour as in the sugarcane.

Ever since the hybridization between *Saccharum officinarum* (P.O.J. 213) and *Bambusa arundinacea* Willd. was successfully effected in the year 1936, a closer study of the two plants has been revealing points of similarity betewen the two in spite of the great disparity in systematic position. This adds yet another character to the list.

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Coimbatore,
March 4, 1940.

On *Epipyrops* (sp. n.): A Parasite on the Nymphs and Adults of the Sugarcane Leaf-hopper (*Pyrilla* sp.)

THE caterpillar of this microlepidoptera was observed parasitising the nymphs and adults of sugarcane leaf-hopper at Muzaffarnagar in October 1934. The parasitic caterpillar is covered with a flocculent white material and is coccid-like in appearance. Its moth was identified as a new species by the Imperial Institute of Entomology, London (*vide* Collection No. 7252, List No. 1332, dated 21st November 1935). This insect has recently been named as *Epipyrops melanoleucea* by T. Brainbrigge Fletcher.

The adult moths are dark blue in colour and measure about 10 to 12 mm. across the wings with greyish brown appendages. Males and females do not vary much in size. The former can be distinguished from the latter by their prominent bushy antennæ and comparatively slender abdomen.

The population of these moths increases after the rainy season is over. From October to middle of December, males have been observed to come out in large numbers in the open spaces in the fields at about 9 O'clock in the morning. They briskly fly about in the sun till about 12 O'clock when they go back to the fields. It is after these flights that males are generally seen in association with female moths which are docile and do not move far from the cocoons after emergence.

The general colouration of the body is pink but it is masked all over with the white flocculent material except on the ventral side in the region of the appendages. The mature larva measures about 5 mm. The head is inconspi-

cuous in size and is turned at right angle to the body. The original contours of the head continue to exist though the mouth parts undergo a change on account of the parasitic habit and work as a sucking organ. Thirteen body segments are there but thorax and abdomen cannot be marked out separately. Every segment has its own covering of the white material. The thoracic appendages have atrophied and the pseudo-legs are sessile with crochets in the form of a circle.

The female moth is fertilised within a few hours after emergence and the eggs are generally laid not far from the cocoon. The eggs are deposited singly in clusters of irregular shape on the surface of the leaf within a few hours of fertilisation which is mostly over by the afternoon. Generally all the eggs numbering about several hundreds are deposited in one egg mass if the female is not disturbed during the process of oviposition.

An individual egg is oval in shape, microscopic in size and dark brown in colour. Incubation lasts for 4 to 5 days. The young larva possesses all the characters of a caterpillar. It is brown in colour with a prominent head, appendages and other body segments. It crawls about briskly in search of its prey for a day or two and attaches itself to some part of the body of the nymphs or wings of the adults. It dies if it fails to spot a host within two days of its active existence. After assuming the parasitic habit the mouth works as a sucking apparatus. Thoracic appendages atrophy. Pseudo-legs become sessile and cease to function. The larva gets mature within a fortnight of parasitic life. During this period the host nymphs or adults move about along with their growing load of parasitic caterpillars. *Pyrilla* nymphs and adults become sluggish and lose much of their agility with the growth of the parasite. Often the nymphs and adults die after they have been released by the parasites.

The mature parasitic caterpillar rolls about on the surface of the leaf leaving behind a white track. It is from the secretion of the white sticky material and alternate strokes of the head from one side to the other that a cocoon is formed. The formation of a cocoon takes about four hours. Pupa is creamy yellow when fresh but gradually becomes brown. It is dorso-ventrally flattened with several rows of spines present on the dorsal surface at the anterior boundary of fifth to eighth abdominal segments. The adult moth emerges after a week or ten days' pupation. On the approach of emergence the cocoon gives way on one side and pupa is dragged out to the opening where it splits for the exit of the moth. An individual life-cycle takes about a month during September and October, *viz.*, egg 4 to 5 days, caterpillar 15 to 20 days, and cocoon 7 to 10 days.

Proportion of male and female moths is more or less equal. The male moth is a quick flier than female. Both live for about a week in captivity. They were tried to live on honey solution in the laboratory but there was no prolongation of their life. The parasite is equally fond of *Pyrilla* nymph as adults.

The over-wintering cocoons issue forth the moths of first brood by the beginning of April when *Pyrilla* adults are quite common. A few cases of parasitisation can be observed in the field at this period. The moths of second brood come out by the first week of May but no sign of parasitisation has so far been observed in the field during the hot weather. With the advent of rain in July the parasitic cases can be seen again. The parasitisation is abundant from August to October and parasite-bearing nymphs and adults as well as cocoons on the leaves are a common sight. Their activity begins to slow down from the beginning of December when the parasitic caterpillars secrete cocoons to lie dormant in winter.

The percentage of its parasitisation increases with the increase of *Pyrilla*. This parasitic species of microlepidoptera remained of academic interest for long. Its economic importance was better understood in the *Pyrilla* epedemic of 1937 38 when they were observed to parasitise about 40% of the nymphs and adults. The one great benefit of this parasite is that adult females of *Pyrilla* become incapable of

oviposition after they have been parasitised by *Epipyrops*.

B. D. GUPTA.

Sugarcane Research Station,
Muzaffarnagar,
February, 2, 1940.

A Note on the Lady-bird Beetles (*Coccinellidae*) Predating upon the Cane White-Fly, *Aleurolobus barodensis* Mask.

THE cane white-fly, *Aleurolobus barodensis* Mask., is a serious pest in Banki which is an important sugarcane-growing tract in Orissa. The conditions which seem to favour the growth of the pest are:—

(*i*) The temperate-humid climate of the place, (*ii*) the practice of ratooning and (*iii*) the application of ammonium sulphate to the canes in order that they may quickly grow high up and escape the regular menace of floods. This practice, however, gives the crop a succulent leafy growth which finds favour with this pest, as with all other sucking insects.

The white-fly being thus abundant on the canes in that area it is not unusual to find its natural enemies like the parasitic hymenoptera and fungi and the coccinellid predators. While the former two categories of enemies have found, however meagre a place in the literature, one finds that practically no attention has been paid to the coccinellid predators. This appears to be due to the fact that the study of Indian *Coccinellidæ* on the whole has been neglected.

During my short stay in the Banki sugarcane tract of Orissa in July and August 1939, I observed the following nine species of coccinellids actively predating upon the various stages of the cane white-fly. For the majority of these coccinellids a record of their preying upon the cane white-fly is new.

1. *Cœlophora octo-signata* Muls.
2. *C. perroteti* Muls.
3. *C. unicolor* var. *romani* Muls.
4. *Cœlophora* sp.
5. *Chilomenes sexmaculata* (Fab.)
6. *Chilocorus nigritus* (Fab.)
7. *Verania discolor* (Fab.)
8. *Scymnus nubilus* Muls.
9. *S. gracilis* Mots.

Of these *C. octosignata*, *C. perroteti*, *C. sexmaculata* and *V. discolor* were breeding in the fields and their grubs were also actively preying upon the pest. *S. gracilis* preyed upon younger stages of the white-fly and also on the mites which were found in certain fields but not very commonly.

I wish to record my thanks to Dr. H. S. Pruthi, Imperial Entomologist, for identifying certain species of coccinellids mentioned in the text and also to Dr. V. K. Badami, Deputy Director of Agriculture, Orissa, for his many acts of kindness during my stay in that Province.

A. P. KAPUR.

Entomological Laboratory,
Srinagar, Kashmir,
February 2, 1940.

A Note on the Chemical Examination of *Celastrus paniculatus*

THE fixed oil from the seeds was examined by O. N. Kumaraswamy and B. L. Manjunath.[1] From the dark brown extract which they obtained with petroleum ether it appears that the 'rich orange coloured arillus' was rejected. They reported the presence of various saturated and unsaturated fatty acids and a sterol melting at 136°. In the course of this work they did not get 'satisfactory evidence for the presence of any alkaloid'.

Gunde and Hilditch[2] have also examined the oil from the husk and from the seeds. But from the dark brown colour that they have noted of the fruit coat extract, they appear to have investigated an old sample of the husk, as it has been noted by the present author that the bright red colour of the husk fades on being exposed to atmosphere. They have not investigated the unsaponifiable fraction besides noting the percentage yield.

The present author took up the examination of the bright orange coloured husk of the seeds

in an attempt to isolate any active principle contained in the drug, the presence of which is warranted by the medicinal properties attributed to the drug.

The bright red coloured petroleum ether extract of the husk on keeping in the frigidaire for a fortnight deposited a white crystalline mass which was found to be a mixture of free fatty acids. The mother liquors after being freed of the solvent were saponified. The unsaponifiable fraction thereby separated, yielded a sterol melting at 184° which gave the characteristic colour reactions of a phytosterol.

The saturated fatty acids fraction appears to contain, besides palmitic and stearic acids a higher melting fraction (90–94°) sparingly soluble in ether and soluble in hot methyl and ethyl alcohol. Working through this method the yields of the different fractions were:—

c.a., 10–15% of saturated free fatty acids.

c.a., 0·8–1·0% of a phytosterol (m.p. 184°).

c.a., 2% of a bright orange red colouring matter.

c.a., 70% saponifiable fatty matter.

The colouring matter contained in the mother liquors of the sterol has not so far been obtained in a crystalline form. It is fat-soluble, dissolves easily in the more common organic solvents and appears to undergo decomposition slowly in air and rapidly in presence of mineral acids. Chromatographic and other experiments for the separation and the purification of the colouring matter are in progress and the results of complete investigation will be published in due course.

Methyl alcoholic extracts of the petroleum ether exhausted drug are also being examined.

SHARIFUDDIN AHMAD WARSI.

Imperial Agricultural Research Institute,
New Delhi,
February 21, 1940.

[1] *J.I.C.S.*, 1936, 353.

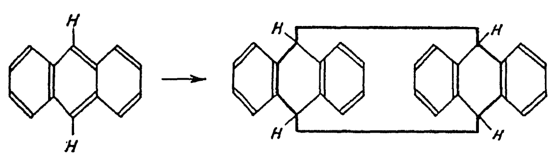
[2] *J.C.S.*, 1938, 1980.

Polymerisation of Anthracene to Dianthracene from the Magnetic Standpoint

IN a recent paper,[1] Bhatnagar, Kapur and Gurbaksh Kaur have reported the results of a study of the polymerisation of anthracene to dianthracene by magnetic susceptibility measurements with a view to determine the constitutive correcting factor, λ, for the cyclo-butane ring. Proceeding on the assumption that the polymerisation involves, among other structural changes of minor significance, (1) the loss of two double bonds and (2) the formation of a four-membered ring as a bridge between the two anthracene rings, and employing the relation

$$\chi_M = 2\chi_A + \lambda,$$

where χ_A and χ_M are the diamagnetic susceptibilities of anthracene and its dimer respectively, they have deduced the value for λ to be $+21\cdot 6 \times 10^{-6}$, as compared with the value, $3\cdot 05 \times 10^{-6}$, obtained by Farquharson and Sastri[2] from the magnetic susceptibility measurements of cyclo-butane carboxylic acid and of *n*-valeric acid. It must be pointed out that in the conversion of anthracene to dianthracene,[3] *no four-membered ring is formed*, but that the bridging group consists of an eight-membered puckered ring, as shown by the thick lines in Fig. 1.



Anthracene   FIG. 1   Dianthracene

In this polymerisation reaction, two anthracene nuclei disappear and four benzene rings are present in the dimeric molecule formed. Since the constitutive factors for benzene and anthracene nuclei are $1\cdot 5 \times 10^{-6}$ and $-16\cdot 2 \times 10^{-6}$ respectively, and net change in the diamagnetic susceptibility to be expected would be $(+2 \times 16\cdot 2 - 4 \times 1\cdot 5) \times 10^{-6}$, *i.e.*, a fall in diamagnetism by roughly 26×10^{-6} units, neglecting the influence of ring-formation. The observed fall in diamagnetism, *viz.*, $21\cdot 6 \times 10^{-6}$, is of this order,

and the difference, *viz.*, about -4×10^{-6}, is of the order to be expected for strain-free rings.

It, therefore, appears probable that the large fall in diamagnetic susceptibility observed in the conversion of anthracene to dianthracene is due principally to the replacement of two anthracene nuclei by systems of bridged benzene nuclei.

J. FARQUHARSON.

Chemistry Department,
University College, Rangoon,

M. V. C. SASTRI.

Department of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
January 31, 1940.

1 Bhatnagar, Kapur and Gurubaksh Kaur, *Proc. Ind. Acad. Sci.*, (A), 1939, **10**, 486.
2 Farquharson and Sastri, *Trans. Farad. Soc.*, 1937, **33**, 1474.
3 Schonberg, *ibid.*, 1936, **32**, 514.

WHEN anthracene polymerises in light to form dianthracene no four-membered ring is formed as is quite clear from the diagram in our original paper on page 469.[1] What happens is that the two anthracene molecules in parallel plane are bridged together through four carbon atoms. Hence the word 'bridged four-membered ring' was coined. One can of course regard the contour of such a bridged structure as an eight-membered puckered ring. There is no doubt that if we calculate the susceptibility value of dianthracene in accordance with the puckered ring structure, *i.e.*, by taking into account the presence of four benzene rings and absence of bi-nuclear carbon atoms, the calculated value of λ does agree well with the observed one but in doing so we assume that the benzenoid character of the middle ring is lost, and consequently no correction for bi-nuclear carbon atoms is applied. There is, however, no support for such an assumption and consequently we coined the word 'bridged four-membered ring' and proceeded to show that its constitutive correction factor is entirely different from a cyclic four-membered ring. Unfortunately the choice of the expression has not been happy as it has caused confusion for example in the preceding letter.

Cyclo octa-diene is another eight-membered cyclic compound which is analogous to the bridged ring suggested in dianthracene. We were not able to trace its susceptibility value and were investigating compounds of this type to clarify the issue when the above letter was forwarded to us.

S. S. BHATNAGAR.
P. L. KAPUR.
GURUBAKSH KAUR (MISS).

University Chemical Laboratories,
Lahore,
February 14, 1940.

1 *Proc. Ind. Acad. Sci.*, (A), 1939, **10**, 468.

The Molecular Weight of the Methyl Ether of Tetrahydro Rottlerone

MCGOOKIN, Robertson and Tittensor[1] mention that "the results obtained in molecular weight determinations were consistently much higher than that demanded by the formula $C_{20}H_{18}O_4$ for rottlerone". But they give no data in support of this contention. We have recently determined the M.W. of the methyl ether of hydrogenated rottlerone, m.p. 101·5°, in benzene. 0·1915 gr. dissolved in 21·975 gr. of benzene gave a lowering of 0·12° whence M.W. is 372. Again 0·1570 gr. dissolved in 21·975 gr. of benzene gave a lowering of 0·099° whence M.W. is 369·5.

The methyl ether $C_{20}H_{20}O_2$ $(OCH_3)_2$ requires M.W. 354, whilst the English authors formulate rottlerone as $C_{41}H_{46}O_8$ and presumably the methyl ether is $C_{45}H_{54}O_8$ requiring M.W. 722. Therefore we are definitely of the opinion that no case has been made out for the doubling of the formula of rottlerone. Therefore, the question arises as to what is the nature of the product of interaction of formaldehyde and 5:7 dihydroxy 8-β-phenyl propionyl 2:2 di-

methyl chroman described by the English authors. As it is identical with the hydrogenated rottlerone and a diphenyl methane type is precluded by the molecular weight determinations, the nature of the reaction is still obscure. Our experiments in this connection are not complete but we are convinced that rottlerone is not a diphenyl methane as pictured by the English authors—the probability is that it is a flavanone. We are elucidating this point and our results will be published shortly.

J. N. RAY.
K. S. NARANG.
B. S. ROY.

University Chemical Laboratories,
Lahore,
March 20, 1940.

[1] *Jour. Chem. Soc.*, 1939, 1579.

A National Research Council for India

THE proposal to inaugurate a National Research Council is one which should be examined very carefully from every point of view. Hitherto, most of the people who have given expression to their views on this subject have had before them the example of the Department of Scientific and Industrial Research in Great Britain. They have consequently pictured the proposed National Research Council somewhat on the lines of this Department. It should, however, be remembered that besides Great Britain other advanced countries also have Departments or Councils which control, finance, promote or co-ordinate scientific and industrial research. Since we are in the position of late-comers in this field and wish to establish a Council now, it is highly desirable that we should take advantage of the experience gained and the lessons learnt by others. I, therefore, think that we should in the first place appoint a small Committee to collect all available information on the subject of industrial research departments or councils from other countries including Great Britain and prepare a small pamphlet showing the constitution of such departments or councils, the principles governing their work and the means by which they attain their objectives in practice.

Whatever may be the future constitution of the proposed Research Council there are some general principles which will have to be considered in this respect. There is, for example, the question of the personnel. In my opinion, it is highly desirable that the majority of the members of such a Council should be scientists and technical experts. They alone can fully appreciate the significance and the relative importance of the scientific investigations, and though they will naturally enlist the help of the laymen so far as routine matters are concerned, the direct control and regulation of the affairs of the Council should be in their hands.

It is presumed that the Council, when constituted, will have funds of its own to devote to the promotion and encouragement of scientific research. In fact, without large funds at its disposal—if the Council is merely expected to work in an advisory capacity—it cannot fully discharge its functions in a satisfactory manner. If the Council is given necessary funds to cater for the scientific needs of the country, it will be very desirable to evolve some kind of machinery to ensure that these funds are utilised properly and to the best advantage. If those, who have the grant of funds in their power, are also expected to submit schemes for scientific and industrial researches, the tendency might develop for a man or a group of men to support another in the hope of a similar compliment. It would, therefore, be necessary to ensure that the examination of the merits of schemes of scientific research and the granting of funds for their prosecution are generally in the hands of completely disinterested and utterly impartial men who are also qualified to apply their minds to these subjects.

One of the main functions of such a Council would be the co-ordination of scientific work in the country. Of late, the term 'co-ordination' has been very frequently used without, I am afraid, a clear understanding of its implications in many cases. While co-ordination on a broad

scale is essential for the prevention of duplication of work and consequent wastage of time and labour, it must not be allowed to assume such a form as to permit undue interference with or strangulation of scientific work. In a country of the size of India, with its numerous complex problems awaiting to be solved, it is sometimes not only inevitable but necessary that more than one person should be engaged on more or less similar work. In such cases co-ordination must be interpreted in a liberal and not in a stringent sense, as otherwise it may have a tendency to place undue power in the hands of those who happen to be associated with the work of the Council.

NAZIR AHMAD.

Indian Central Cotton Committee,
Bombay,
February 27, 1940.

I ENTIRELY agree to the proposal for instituting a Central National Research Council which should explore and adopt means for organising and developing all the industrial researches in our country, and which at the same time should work in co-operation with and be *the co-ordinating agent* for all the existing industrial research departments in India. Needless to say, it is with the fullest of co-operation that the thing could work most successfully.

B. K. DAS.

Osmania University, Hyderabad (Dn.),
Zoology Department,
February 25, 1940.

THE country certainly needs a central co-ordinating agency for guiding industrial research, if there is to be no set-back to the hard-won industrial progress of the last two decades. This need is nowhere felt greater than in the mineral industries, where the raw produce of the mines, the ores and industrially vital minerals have been allowed to leave the country in ever-increasing tonnages simply because of lack of technical guidance in the processes of dressing, refining and manufacture of raw minerals for fitting them to the needs of commerce and industry. Whether the proposed research organisation functions independently or as a Government department or on lines analogous to the Mellon Institute of the U.S.A., it should not lose its character, mainly as a national advisory council for planning and directing industrial research.

D. N. WADIA.

Department of Mineralogy,
Torrington Square,
Colombo,
March 5, 1940.

IN response to the Editor's request for a short note on the above subject I would draw attention to the following aspects of the question:

(*a*) What has happened to the Reports and Recommendations of the Holland Industrial Commission which was so active during the Great War and from which so much was anticipated?

(*b*) Could not more be done to advertise the bulletins at present being published under Government authority? Thus the excellent *Bibliography of Industrial Publications*, Bulletin No. 1 of the Industrial Research Bureau, does not seem to be widely known. Local publishing agents do not apparently keep any serious stock of Government publications and consequently some time and trouble is necessary to procure them from Simla if they are even then available.

(*c*) Effort should be made to co-ordinate large-scale and cottage industries on the lines developed by Henry Ford in connection with his motor industry. With the extension of electrical power transmission to the villages this should not be too difficult of accomplishment.

(*d*) Before starting new industries those at present in operation should be, if possible, improved and perfected.

(*e*) It should be particularly realized that the driving power behind industrial development nearly always depends on the availability of men of outstanding force and special aptitude. Such men should be carefully sought for among the younger generation. It may be sadly recorded that India has suffered a great loss in this respect from the premature passing of J. A. D. Naoroji.

(f) Finally, the present Industrial Research Council with its co-ordinated practical expression in the Industrial Research Bureau may well serve as a nucleus for the larger body which is the subject of the present discussion.

GILBERT J. FOWLER.

Madras,
March 1, 1940.

THE proposed Council should consist of experts representing all phases of industrial manufacture in India, who should be well-informed of world progress in their respective branches and capable of advising on the value of projected developments. They would work under an unbiassed chairman of experienced organising ability.

The Council should be so expert as to be able to guide the exploitation of both the natural resources and the capital of India in the desired directions. It should determine the deficiency and surplus of commodities in the present and future needs of India, demonstrate methods and processes found of value in other countries and pursue new ideas so as to attract private and public capital and enterprise, and generally promote research into manufacture. It should set up bureaux of trade and scientific information and advice, an institution to standardize methods and materials, laboratories for industrial chemistry and physics and engineering, and send *liaison* officers abroad to inform on the disposal of India's exports. A free hand should be given to guide and rationalise industrial research already in progress. The immediate problem is economic—to find out major defects in India's self-sufficiency and to promote these industries.

W. L. DAVIES.

New Delhi,
March 5, 1940.

A NUMBER of industries have their problems solved in science institutions, by making extra provision in their original equipment. This would be economical to the industries which cannot maintain special laboratories of their own.

There should be provision in existing libraries for classified literature, edited in a suitable form, to help existing and new industrial concerns. Industries may be called upon to make contributions in this direction.

A complete register should be maintained of industrially useful scientific researchers with topics that they can handle so far as information and facilities are available. The actual problems of different industries should also be registered and arrangements made for their solution.

Accurate information regarding raw materials, processing, testing and marketing could be given through the establishment of standardizing and testing laboratories. These will be necessary to numerous smaller industrial concerns that cannot be expected to maintain special testing and expensive appliances.

G. R. PARANJPE.

Royal Institute of Science,
Bombay,
March 6, 1940.

IN proportion to the size and resources of India there are not yet adequate facilities for scientific research, especially in connection with industrial research. Attempts are being made to utilise the resources of the Indian Institute of Science to further this cause and one can but hope that these efforts will succeed. The Universities in India are doing more and more scientific work. It would be surely desirable to have a definite plan of scientific research and this can best be done by an all-India body like the National Research Council. In this venture it is necessary to gain the good-will of industrialists who should be prepared to take advantage of opportunities for scientific research. An army of scientists working in every industrial concern would tend to improve the quality of work, while it would harness the scientific genius and talent in our country.

A. R. WADIA.

Maharaja's College,
Mysore,
March 11, 1940.

REVIEWS

Annual Review of Biochemistry, Vol. VIII. By James Murray Luck and James H. C. Smith. (Annual Reviews Inc., Stanford University P.O., California), 1939. Pp. ix + 676. Price $5·00.

Progress in the field of Biochemistry during the last few years has been both rapid and spectacular; the intimate bearing of the subject on problems of human welfare, human physiology, pathology and nutrition, and the great fascination of a rich harvest offered by a virgin field, have been responsible for the wealth of material which has accumulated. During this eventful period of scientific achievement, the *Annual Review of Biochemistry* has played useful and praiseworthy part in marshelling together the widely scattered facts and tailoring them into a presentable, cogent and thought-provoking picture. It is difficult to assess the value of these reviews in terms of the "brain waves" which they generate in the mind of the experienced investigator as he reads them. It is in this direction of provoking thought and promoting fresh endeavour, that the value of such reviews lie, and it is in this manner that the *Annual Review* has been serving and will continue to serve the cause of the advancement of biochemistry.

The eighth volume of the *Annual Review* records an all-round and substantial progress in biochemistry. In the field of biological oxidations and reductions, the year has witnessed the discovery of a new co-enzymic nucleotide by Warburg, a new catalytic flavo-protein from milk by Green and the "diaphorase" by Euler which supplies the missing link in the respiratory mechanism of animal tissues and accounts for the reaction of the reduced coenzyme with oxygen. Professor Tiselius' contribution on the chemistry of proteins and amino-acids, is specially devoted to a discussion of certain physico-chemical properties of proteins, relating to size, shape and stability as revealed by ultra-centrifugal investigations. Proteoclastic enzymes are reviewed by Professor Linderstrom-Lang while Professor Myrbäck deals with the non-proteolytic group, which contains a critical summary of his contributions to the nature of the reaction products of the enzymatic degradation of starch. Choline as a dietary factor, is discussed by Professor Best and his collaborator. King's contribution on the water-soluble vitamins is exhaustive and critical. It includes all the available information regarding the physiological function of the components of the vitamin B group and of the other water-soluble vitamins.

The review includes two refreshingly unfamiliar and exciting contributions, animal poisons by Kellaway and ruminant nutrition by Marston. There are other reviews, brain and nerve, lipid, protein and mineral metabolism, etc., equally important and interesting.

With the birth of the new companion series, *Annual Review of Physiology*, the strain on this *Review* will be considerably eased and the volumes of this series will discuss aspects of a more chemical character. This tendency is already reflected in the present volume.

The *Annual Review* is an indispensable part of the scientific equipment of every investigator who wishes to keep abreast of the progress of biochemistry. The service which the *Review* has rendered to the scientific community during the last eight years of its career entitles it to our deep gratitude.

M. S.

Ergebnisse der Enzymforschung, Band VIII. Edited by F. F. Nord and R. Weidenhagen. (Akademische-Verlagsgesellschaft, M.B.H., Leipzig), 1939. Pp. x + 324. Price R.M. 28.

Eleven contributions including two from India, comprise the eighth volume of this well-known and internationally recognised series. They cover a wide variety of subjects, viruses, nitrogen fixation, pH optima of digestive enzymes in vertebrates, enzymes of wood rotting fungi, the genetics and biochemistry of flower colour variation, etc.

The article on the preparation, purification and properties of the virus protein, also contains a review of the author's ultra-centrifugal studies on the size and shape of virus particles. Wilson's contribution on the mechanism of nitrogen fixation, clarifies the position of this difficult and intriguing problem and presents a critical discussion of

the various hypotheses relating to the question of the intermediate product of fixation advanced by different workers.

Of special interest is the article on the importance of enzymes in clinical diagnosis, by Ammon and Chytrek, which gives striking instances in which tissues and tissue fluids in their pathological state, suffer a pronounced and measurable alteration in their enzymatic make-up. Immuno-chemists will find the contribution on the enzymatic analysis of the antigenic structure of pneumococci extremely stimulating. In this article one will find a considerable amount of new and extremely useful technique, helpful in cytochemical investigations.

Other articles of fundamental interest include a review of the low molecular weight "überträger"s or coenzymes and their function in biological oxido-reduction systems, and a resume of our knowledge regarding aldehyde mutase by Dixon. Professor Nord, the enterprising editor of the series, has contributed an article on the enzymatic decompositions brought about by fusaria, which incorporates a substantial portion of his own work in this field. Attention should be invited to the excellent article on the respiration of animal tissues by Martius, which discusses, in a clear manner, the catalytic rôle of the dicarboxylic acids, first investigated by Szent Györgyi.

The volume has fulfilled the high expectations to which we are accustomed. This international enterprise will suffer a regretful set-back as a result of the War in Europe and we shall not have the privilege of reviewing the ninth volume of the series for some time. Let us hope for the speedy dawn of peace and for the early appearance of the ninth volume, which will be enthusiastically welcomed by seekers of biochemical knowledge, the world over. M. S.

Handbook of Chemistry. By Norbert Adolph Lange. Third edition. (Handbook Publishers Inc., Ohio), 1939. Pp. 1543 + 249 + 34. Price $6·00.

The third edition of this handbook which has recently made its appearance, has fully maintained its established reputation as the largest and best book of its kind yet published.

The present edition is an improvement over the previous ones in several ways: Six new tables, not found in the second edition, have been offered for the first time; these are: (1) Physical and mechanical properties of cast metals, (2) Reduction of barometer readings to sea-level, (3) Symbols of thermo- and physico-chemical quantities, (4) Dimensional formulas, (5) Properties of various photographic film emulsions, and (6) Comparative photographic emulsion speed ratings. A number of tables representing some 167 pages, have undergone thorough revision in order to bring the information up to date. Another decisive improvement is the successful attempt made to render the book "self-defining"; this has been achieved by the inclusion of a new section giving the definitions of all column headings and technical terms used in the handbook, tables of the commonly accepted thermo- and physico-chemical symbols and a table of dimensional formulas.

The reviewer has been using *Lange's Handbook* during a period of over five years and it has never failed him. There is hardly any information required by a chemist or chemical engineer which is not presented in this book in a clear and unambiguous manner. All pertinent information widely scattered in chemical or physical literature has been classified and presented and within its covers are arranged tables of interest to workers in mineralogy, X-rays, physiological chemistry, electro-chemistry, foods, drugs, bacteriology, medicine, physics, metallurgy, etc. The printing is clear and the get-up excellent; the handbook fully maintains its reputation as the most comprehensive work of its kind.

Mathematics Applied to Electrical Engineering. By A. G. Warren. (Chapman & Hall, Ltd., London), 1939. Pp. 400, Figs. 132. Price 15*sh.*

This book forms volume nine of "A Series of Monographs on Electrical Engineering", edited by Mr. H. P. Young. The book is divided into 22 chapters followed by three useful appendices, a bibliography and an index.

No branch of Engineering requires such a high standard and variety of mathematics as Electrical Engineering does. A book, such as the one under review, containing "all the mathematics required by Electrical Engineers", followed by worked examples illustrating the applications, has been a long-felt want. True, there have been many books published under somewhat similar title but a perusal of such books always

gave the impression that the stress was more on the mathematical results rather than on the engineering significance. 'The outlook of the Mathematician differs from that of the Engineer.' Mr. Warren deserves to be congratulated for, though he deals in the book "high order mathematics", he writes it essentially with the outlook of an Engineer. It is felt that in this book most of the mathematical needs of all classes of Electrical Engineers have not only been fully recognized but satisfied.

The book is not meant for the undergraduate, though one appearing for the degree may read it with profit, in the first 16 chapters. It is meant for the advanced student and Engineer. It presupposes a groundwork in mathematics during the fundamental degree course in any university, as the treatment of 'Calculus' is but brief and pertains to immediate applications to Electrical Engineering.

A special feature of the book is the large number of worked examples, illustrating the applications. Any one can read often Chapter V, which contains a very concise and yet useful resumé of the fundamental Electrostatic, Magnetic and Electromagnetic relations.

In general, the treatment of differential equations (Chapters X to XVI and XIX) deserves special notice. Such advanced subjects like the Bessel, Beta, Gamma functions, Fourier Series and Harmonic Analysis, Heaviside's operational calculus, conjugate functions—(not usually taught for the fundamental degree)—are covered in a lucid manner in the later chapters (XVII, XVIII and XX to XXII). These chapters are, however, specially commended to Communication Engineers. But these may be omitted, unless one needs them.

The style throughout is straightforward and clear, though on occasions one wished the author had been a little more elaborate and explanatory, but then this criticism could, perhaps, be dismissed on the ground that the book was not meant to be an Elementary Text-Book, but a monograph for the advanced student, Engineer and Research Worker.

While the problems in Communication Engineering have been dealt with in considerable detail, it is felt that similar attention has not been devoted to portions in Power Engineering. For example, that vast subject of recent origin—'Symmetrical Components' has just been touched in but a few pages towards the end of Chapter VII. It certainly deserves a more generous treatment especially its applications to short-circuit calculations; and, the treatment of 'Vectors' in Chapter VII appears a bit too meagre. Perhaps, the object of the 'Bibliography' at the end of the book is that any reader interested more deeply in any one subject should choose a specialised treatise recommended therein.

It is considered that the utility of the book would be enhanced by including the following: Determinants, Matrices, Methods of formulating equations or laws from experimental results or curves, methods of preparing nomograms. The author may include them in a revised edition.

The book is warmly recommended to all Electrical Engineers power or communications who have any flair for mathematics. The author deserves all credit for producing such a book, wherein he has given some thirty years' experience of Engineering education and research. The general get-up of the volume is excellent and the price reasonable.

V. V. L. R.

A Text-Book of Geomorphology. By Philip G. Worcester. (Chapman & Hall Ltd., London), 1939. Pp. 565. Price 22/6.

Geomorphology, the scientific study of land-forms and interpretative description of the relief features of the earth, is the science that has emerged from the reaction of geology on geography. The cultural value of such a study to the ordinary man in his outdoor life is being recognized on all hands now. The intelligent interpretation of his physical environment, and the seeking of the meaning of the mountains, rivers, lakes, plains and plateaus which he views around him daily can be the means of an enduring pleasure to the modern man of education and culture.

The present book is a handsome volume of 565 pages, containing 375 illustrations and photographs, many of them of great scenic value and beauty. The text is written in a manner which does not presuppose or demand any geological knowledge from the reader. By simple explanation of geological terms and expressions and by the elimination of technical language the author has succeeded in driving home, the general principles on which nature has worked in imprinting on the earth's face its existing

physiognomy. While the majority of the examples and illustrations are drawn from America, a few are chosen from other parts of the world. Excellent as the illustrations from nature are, a few diagrammatic and block figures and sections would have helped the explanations of the text to a considerable extent. The subject of Earth Movements and Structure of the Earth has received rather inadequate attention—barely 28 pages; these important agencies in the dynamics of the earth which have played a large part in shaping the "last chapter of earth history", *viz.*, its present geography, could well have been treated a little more expansively.

The book will be found useful and interesting by the general reader besides the students of geography and geology.

D. N. WADIA.

Propagation of Horticultural Plants. By Guy W. Adrianace and Fred R. Brison. (McGraw-Hill Publishing Company, Ltd., Aldwych House, London, W.C. 2), 1939. Pp. 314. Price 20*sh.*

The basic principles of all the practices followed in the propagation of plants are set out clearly. Though the book does not deal with the subject in such minute and exhaustive detail as one would wish, it serves its purpose as a guide for practical work. Latest researches on the subject such as the utility of plant harmones and synthetic growth substances used to stimulate root formation and plant growth have been touched upon. The suggested references at the end of each chapter would be useful to those who would seek further enlightenment.

The first three chapters easily prepare the student to scientifically understand and follow the several practices mentioned in the later parts of the book. Chapter IV deals with the important subject of germination of seeds and seed treatments to control disease. Chapter V mentions the several types of forcing structures such as cold frames, hotbeds, green houses and solar propagating frames and explains their uses and management. Chapter VII deals with the raising of several classes of "Bulbous plants". Chapter VIII deals with the multiplication of plants by layering; Chapter IX with multiplication by root, stem and leaf cuttings. The science of grafting, its objects, applications and limits are dealt with in Chapter X. The succeeding two chapters give an idea of the implements and accessories necessary for grafting operations and how these are carried on. Of the several methods suggested, the "approach" method is, however, the only one suited for our hot country. Methods and principles of budding are found dealt with in Chapter XIII. Chapter XIV is a large one giving an account of particular practices followed in producing healthy and disease-resisting plants for planting out extensively in orchards. Though almost all the kinds treated are subtropical plants such as peach, plum, apricot, cherry, almond, apple, pear, pecan, walnut, persimmon, etc., the notes on grape vine, citrus plants, avocado and the rose offer very useful information to us. The last two chapters deal with the essentials of transplanting operations and the growing and handling of nursery stock.

Like other McGraw publications, this book is bound to take its place as a standard treatise on Plant Propagation. It is invaluable to amateur gardeners, professional nurserymen, farmers and orchardists alike, as there are very few text-books on the subject dealing in such a masterly way. It is profusely illustrated and the printing and get-up leave nothing to be desired.

K. S. GOPALASWAMIENGAR.

Where Theosophy and Science Meet.—A Stimulus to Modern Thought—A Collective work. Edited by D. D. Kanga, I.E.S. (Retd.). Part IV—*Some Practical Applications.* (Vasanta Press, Adyar, Madras.) Pp. lxix + 223. Price Rs. 2–4–0.

"Most gratefully dedicated to HELENA PETROVNA BLAVATSKY as a loving and humble tribute on the occasion of the semi-centenary of the publication of the *Secret Doctrine*, 1888–1938", the fourth part of the work entitled "Where Theosophy and Science Meet" deals with "Some Practical Applications" quite in conformity with the law that theoretical principles and doctrines should be translated into practical applications. The volume or part under notice opens with a contribution by C. Jinarajadasa who writes on "Methods of Research". He holds that the method pursued by modern science, the Inductive method grounded on laboratory analysis, formation of hypothesis and verification will have to be ready to create a new technique. He writes *con amore* on Bergson's "Intuition" in the development of which the

next advance would consist. He concludes "When science some day will state that an unit of life goes with each particle as does the electric charge, *science will have become Theosophy*" (italics mine). Dr. D. H. Prins follows up with his contribution on "Psychical Research" in which he believes that Science and Theosophy can meet. M. Beddow Bayly writes on "Medicine". Part I of the article is a brief historical survey of the Western Theory and Practice of Medicine. An attempt is made in Part II to show that "much of the knowledge and skill claimed as the achievement of modern science can be traced in part at least in the medical systems of ancient India, Egypt, Greece and even China" (p. 40). Adeltha H. Peterson draws attention to the "baffling mystery of the variations in terrestrial magnetism". What is the theosophical solution of the mystery? The Earth is to be considered a "living being". Just as man has *chakras* (force-centres), the Earth has similar force-centres. Secondly, Theosophy speaks of a Plan of the World administered by an Inner Government (p. 74). The writer is convinced "that these Messengers of Inner Government knew of the mystery of magnetic variation" (p. 81). Charles E. Luntz explains the value and significance of "Astrology" which will surely be recognized by science. A. Rangaswamy Iyer writing on "Law", explains the evolution of the concept in reference to Root-races and sub-races. Peter Freeman elucidates how Theosophy is to be applied in practice to Politics and Government. How is World-Peace to be secured? How is Brotherhood of Man to be established? The author sketches a scheme of Declaration of Brotherhood and Human Rights. What would be the future Government? Democracy would be maintained doubtless, but, it will be co-ordinated with accepted aristocracy. The Best men for Government would be chosen on Dr. Besant's Scheme of Graded Franchise. The Theosophical Ideal of "Education" is expounded by Julia K. Sommer. The Self is to be educated, and Education should be directed to hastening the advent of the new human type. "And what of Art?" asks Claude Bragdon, and answers that the "prime requisite of great art is a rich spiritual life" (p. 194). "The union of intuition and reason, the fusion of Theosophy and Science, and the marriage of East and West is the consummation devoutly to be wished." "Whither Science?" interrogates Iwan A. Hawliczek. What were the changes in the past? How did they prepare the way for science in its present form? In what direction scientific research is likely to proceed in the future? These questions are answered by the author with an unmistakable theosophical orientation. In future, science "facts will take second place and potencies will occupy the position of major importance" (p. 206).

From the summaries of the contributions (necessarily brief on account of Editorial warning due to enhanced printing charges) sketched above, it must be obvious that the different writers have consistently repeated the conclusion in some form or another that modern scientific conclusions had been anticipated by theosophical teachers. Be that as it may, general reflections are recorded in the "Introduction" by D. D. Kanga, Editor of the series of monographs, to which attention should be directed. The "occult method" does not mark any departure from the "scientific method", but, it is merely an extension of it. When for whatever reasons or satisfaction of whatever exigencies, one and the same method is extended to certain hitherto unobserved facts or phenomena, it does not seem intelligible at all why there should be such startling differences and divergences in results. D. D. Kanga emphatically asserts that the scientific method or scientific training and discipline as he would put it, would appear to fail to change the heart of man. The scientific training and discipline "may make him an intellectual giant *but not a good man, clean in life, and pure at heart* ...." (p. xxxvi). The claim is made that the occult method is bound to succeed where the scientific method fails. D. D. Kanga throws out in fact an uncompromising challenge which I am sure scientists would take up and adequately answer. The charge that scientific training and discipline do not contribute to building up of pure heart and clean life is seriously damaging, and, I am able to detect a serious confusion of thought which alone should be held responsible for the adumbration or the promulgation of the charge. That certain celebrated achievements of modern science have been unscrupulously made use of in widespread destruction of fellowmen in wars is one thing, and scientific methodology aiming at discoveries, totally another. There is nothing inherently incompatible in the constitution of human nature of a scientist and a clean

life and a pure heart. An intellectual giant may well be morally most perfect and spotless. It is rather the other side of the shield which must attract those who may not have surrendered independent reflection and critical judgment. One must refuse to admit on *a priori* grounds that those who claim to pursue the occult method and enjoy its benefits are the paragons of moral and spiritual perfection. If the occult method is merely an extension of the scientific method, and if the pursuit of the scientific method fails to bring about moral and spiritual transformation of personality, how can the extension of the method *qua* extension enjoy immunity from the ills incidental to or concomitant with the very scientific method simply because the extension happens to be christened "occult"? I may state I have very carefully studied the monographs and nowhere is any demonstration or verification forthcoming to the effect that the extension of the scientific method, when it develops into the "occult", acquires altogether new properties, new potencies, and new efficacies. I have no quarrel as such either with the occult or with the scientific method. The occult method has its own sins of omission and commission even as the scientific. The kettle can never be permitted with impunity to malign the pot on the comic chromatic issue!! The four parts together have to be admitted to be a remarkable achievement. From Nature to Man, from Man to God, progress is sketched with care and caution, circumspection and constructive suggestions. One may or may not agree with the conclusions arrived at. The general series—where Theosophy and Science meet—is a magnificent co-operative concern on which the Editor and contributors have to be sincerely congratulated. While thus congratulating, I must emphatically protest against Jinarajadasa making Kapila the author of *Sankhya-Karika* (p. 10). No. The real author of the work was Iswara-Krishna. Sooner or later, it must be realized that both the occult and the scientific methods would yield but partial pictures of Reality. Both are partial. Both are truncated. Both are distorted. Both are heavily camouflaged. Both should be transcended in favour of a third. Only then can there be any talk at all of any meeting between "Science and Theosophy".

R. NAGARAJA SARMA.

Nomenclator Zoologicus, Vol. I. Edited by S. A. Neave. (Chapman & Hall, Ltd., London), 1939. Pp. xiv + 958. Price 17*sh*. 6*d*.

An enterprise of a pioneer nature has been started under the auspices of the *Zoological Society of London*. It is a four-volume work embodying the names of genera and subgenera of all the animals known and described till the end of 1935, of which the first volume has been published. Edited by Dr. Sheffield Airey Neave, of the *Imperial Institute of Entomology*, the work is the result of the combined labours of many famous zoologists of Great Britain, who have all contributed in making the work as authoritative as possible.

On completion the work is expected to contain more than 225,000 entries, of which, barring supplementary references and alternative spellings a total of about 192,000 entries represents the names of the known genera and subgenera of animals.

The first of the four volumes contains entries A–C and the other three are expected shortly. It is impossible to overestimate the usefulness of this work as a valuable reference book to zoologists and there is hardly any doubt that it will be a distinct addition to every zoological library in the world.

A. S. R.

Chemical Spectroscopy. By Wallace R. Brode. (Chapman & Hall, Ltd., London), 1939. Pp. 494. Price 36/-.

The spectrograph is now recognised as a useful adjunct to chemical analysis in all laboratories, and in some it is indeed a necessity. This modern industrial tool was at one time but a scientific device, the manipulation of which was associated with specialised experience in fundamental researches on spectra of elements and molecules. The contributions made, principally during the last decade, by Gerlach, Meggers, Twyman, Lundegardh, and others to the application of spectroscopic technique in chemical analysis, have gone a long way towards establishing the practice of this method. In the field of estimating minor constituents and impurities, particularly of a metallic character, the spectrograph possesses overwhelming advantages both in the speed and accuracy with which routine analysis can be carried out. Sensitiveness of one part in a million and speeds of 30 to

50 analyses a day, have been reached with modern technique. However, it would appear that except for some biological assays, no general official recognition has yet been given to this method of analysis. This may be due to the pitfalls that are still associated with quantitative emission spectra analysis and indicates the need for more work towards the standardisation of methods.

The book under notice purports to supply spectroscopic information to chemical workers and to serve also as a text-book for a course in chemical spectroscopy. As quite a third of the space in the book is covered by tables of principal and persistent lines of elements, and thirty-five charts of the iron spectrum with indicated line positions of other elements, it also forms a valuable reference text. A useful bibliography is provided. A feature of the book is the twelve laboratory experiments with full directions, comprising Chapter XII. Chapters XIII and XIV deal with theory and practice of photography, and the equipment and arrangement of a spectrographic laboratory, respectively.

Some of the chapters of the book intending to supply spectroscopic information such as those on resonance and chemical structure, and infra-red and Raman spectra, are wanting in their method of presentation and suffer from a too brief treatment. This latter is apparently due to the attempt to cover all aspects of spectroscopy within the compass of this book which is essentially of the nature of a *vade mecum*.

M. A. G. RAU.

Mr. Tompkins in Wonderland. By G. Gamow. (The Cambridge University Press, London), 1939. Pp. 91. Price *7sh. 6d.*

The last two decades constitute a most exciting period in the history of scientific thought. Epoch-making discoveries. and startling adventures along new paths, have enriched this period as never before. But, the more profound of these concepts have been rather reserved for the delectation of the trained mathematicians. Einstein's Relativity Theory, Planck's Quantum of Action, Heisenberg's Matrix Mechanics and Principle of Uncertainty, Dirac's Symbolic Developments in Operational Mechanics, and L. de Broglie and Schroedinger's Wave Mechanics, are some of these blazing aspects of modern physics. However the ordinary man (and woman) including the 'lesser' non-mathematical scientists, are anxious to have some concept, at least some elementary ideas, about them. Although it is true that the frigid beauty of these developments must remain beyond their reach unless they take pains to gain an entry into the ranks of mathematicians and mathematical physicists, efforts have not been wanting on the part of the latter, to expound these new ideas in non-mathematical terms.

The book under notice is definitely one of the outstanding attempts in this direction. Prof. Gamow is an eminent Theoretical Physicist and is well known in academic physicist circles. But this book will at once make him popular among a much wider circle of grateful readers. The presentation, developed in the style of Lewis Caroll's "Alice in Wonderland", has been also given the alternative title of "Stories of c, G and h". Mr. Tompkins, a hard worked bank clerk, attends for the sake of diversion, a course of three profound University Extension Lectures, feels dazed by the high lights of science, and falls into a series of six dreams. In these dreams, he is wafted into new worlds with different values for physical constants which limit the applicability of the classical physical laws and demand rather novel changes in his usual and fundamental concepts of space, time and motion. At one time, he is much amused by his adventures in a relativistic city, as when a nice old lady addresses a gentleman obviously in his forties, as 'Dear Grandfather'. Another time, he gets into a "quantum jungle" where a large pack of tigers attack the elephant, jumping simultaneously from all sides. Well, as the film world will say, the reader must look for the rest in this inimitably written book. The publishers rightly point out in the wrapper that "Modern physics has come to stay, and this is its visiting card". The book is beautifully illustrated by John Hookam, and its cost is quite reasonable.

M. A. G. RAU.

CONTEMPORARY PHYSICS

Introduction to Contemporary Physics. By Karl K. Darrow. (Macmillan & Co., London), 1939. Second edition. Pp. 648. Price 25*sh*.

CONTEMPORARY PHYSICS is in large measure the physics of the atom. It was developed with great rapidity, and one cannot help but admire the valiant authors who from time to time have endeavoured to portray this kaleidoscopic scene, and mark out a path for the student to walk in. The decade of the twenties saw the first editions of many well-known books, which, though inevitably out of date almost as soon as they were printed, provided many of us with our first introduction to this fascinating field.

We have now reached the stage where the ephemeral books have disappeared altogether, and the better ones are passing into second and third editions. The volume under review is a case in point. The first edition was published in 1927, and the present volume, dated 1939, is the second. To compare the two is to see at a glance the astonishing progress that has been made in the intervening twelve years. The number of pages has grown from 453 to 648, but this hardly indicates the fundamental character of the changes. The new edition is not merely the old, with an addendum of 200 pages, but is essentially a new book. Facts known in 1927 are still facts, but as understanding of them has grown, so the interpretation placed upon them has changed. Accordingly Dr. Darrow has revised, and in large measure re-written, the whole text.

It may be said at once that the book in this edition retains those excellent features which made it so useful to students a dozen years ago. Dr. Darrow has an enviable gift of clear and succinct expression, in spite of an occasional fault of syntax and the introduction of neologisms such as 'uniformize'. But the latter are rare, and as a whole the book is extremely readable. The chapter 'Introduction to Wave-Mechanics', for example, is an instance of lucid exposition which can be read by the intelligent beginner with sustained interest.

A substantial part of the subject-matter, roughly the contents of the first half of the book, was in the old edition. Comparing for example the present chapter on the Analysis of Spectra with the corresponding one in the former edition, we find that whereas the paragraphs may for many pages follow the same order, in much the same language, there is evidence in a host of minor alterations of a painstaking and detailed revision.

The essentially new matter starts with wave-mechanics, and carries the reader on through the whole development of nuclear physics. Stress is laid more on the experimental facts and their general interpretation, and there is little or no attempt to dip into the theory of the nucleus. This method is doubtless right for a book of this type; the theories are in a state of flux, and possibly the third edition will provide an opportunity to discuss them. The experimental work is well selected and described, and the reader gets a very clear picture of the present position regarding such matters as nuclear transmutation and nuclear spins. The most striking omission is cosmic radiation, which obtains only incidental mention in connection with the positive electron. The omission is possibly deliberate, in view of the size of the book, but it is to be regretted, for cosmic radiation now looms very large in our picture of contemporary physics.

Readers of the old edition will regret the disappearance of the concluding chapter on the conduction of electricity through gases, which was a very useful summary of that subject, but many of its topics are mentioned at appropriate points in the new edition.

To those who used this book in its earlier form no commendation is necessary. To new readers it may be unreservedly recommended as an extremely interesting and reliable account of almost the whole field of atomic physics. It should in particular be read by honours students who desire not merely a compendium of facts, but a book which will bring them a wider and deeper understanding of the methods and the ideas which underlie the remarkable developments of contemporary physics.

H. J. T.

CENTENARIES

Lahire, Philippe De (1640–1719)

PHILIPPE DE LAHIRE, a French mathematician, was born at Paris, March 18, 1640. His father was an artist and following his footsteps Lahire first practised painting and sculpture. When he visited Venice in 1660 partly for health and partly for improving his professional knowledge, he changed over to mathematics, particularly to the geometry of the conics.

A Prolific Writer

On return to his native country, he became professor of mathematics in the Royal College of France. He wrote about nine books, mostly on geometry. The first book was entitled *Theorie de coniques* (1672). The last was published in 1702 and it was an astronomical table. Besides these he contributed over 50 articles to learned periodicals. He did not use the calculus in any of his investigations.

Geodetic Work

In 1679 he was commissioned by the King to survey the coast of Gascony along with Picard to obtain data for a general map of France. In 1683, he was engaged in the measurement of the meredian. He was also employed in determining the difference in level of the river Eure and the reservoir of Versailles, preparatory to the construction of an aqueduct for water supply.

Lahire died at Paris, April 21, 1719.

Olbers, Henrich Wilhelm Mathias (1758–1840)

HENRICH WILHELM MATHIAS OLBERS, a German doctor by profession, who is now remembered for his astronomical discoveries, was born at Arbergen near Bremen, October 11, 1758. He studied medicine in Gottingen. Throughout his long life his time was divided between the practice of his profession and the pursuit of his astronomical hobby.

His Private Observatory

He maintained a private observatory, believed to have been the best of those that then existed in Germany. It was equipped with two five-feet telescopes, an astronomical clock, a quadrant and a sextant; but it did not have a transit instrument or a mural circle. Attached to it was an astronomical library which was rich in cometography. This library was later purchased by the Emperor of Russia for the Observatory of Pulkowa.

Comets First

Olbers came to be known to astronomers by his observations of the comet of 1779. He made improvements in the method of calculating the elements of a comet's orbit. An account of his method was published at Weimer in 1797 and later incorporated in Delambre's *Astronomie*. Olbers calculated the orbit of all the comets that appeared later in his time down to the great comet of 1811. In 1826 he investigated the probability for a collision of the earth with comets.

Discoverer of Asteroids

An empirical law of planetary distances put forward by Titus, a contemporary of Keplar, was restated by Bode in 1772; and this led to a strong conviction that a planet should exist between Mars and Jupiter and the formation of a society of twenty-four astronomers to devote itself to the search. But though the credit of first sighting one of them (1801) went to Piazzi of the Palermo Observatory, who was outside this Society, he soon lost track of it. It was Olbers who accurately calculated its orbit and caught it again in 1802. A few months later he discovered a second asteroid and a still another six years later. The discovery of so many tiny asteroids in closely adjacent orbits led Olbers to suggest the idea that they were fragments of an exploded planet.

The Olbersia

The photographic method has now led to the discovery of nearly 2,000 asteroids. Olbers' name has been immortalised by the use of the term Olbersia to designate the asteroid numbered 1,002. Olbers was elected a Fellow of the Royal Society in 1804 and besides being made a member of several other learned bodies he was knighted by the King of Prussia; and his fellow-citizens at Bremen placed his bust in the public library of the city.

Olbers died at Bremen, March 2, 1840.

Maclure, William (1763–1840)

WILLIAM MACLURE, a pioneer geologist of America, was born in Ayr, Scotland, October 27, 1763. He had his early education from a tutor but he was always disposed to reject the learning of the schools for the simpler and more attractive truths of natural history. His vocation was commerce, while his hobby was natural history. In his travels he used to collect specimens and books of natural history for deposit in the United States which became his adopted country in 1803.

First Geological Map

As soon as he settled down in America, he commenced a most important scientific enterprise on which he had long contemplated as the ambition of his life, *viz.*, a geological survey of the United States. The greater part of the country was then a wilderness; nevertheless, he went forth alone and at his own expense and collected enough data for a paper to be printed in 1809 in the *Transactions* of the American Philosophical Society. This paper was in explanation of a geological map of the United States he constructed, the first map of

its scope in the history of geology. He went out again in search of data which rendered a second edition necessary as early as 1817.

Taken to be Lunatic

In after-life he often recollected with pleasure his experiences in this pioneer survey and beheld with unmixed pleasure the progress of geology in America, state after state arranging geological survey on a permanent official basis. When travelling in some remote districts, the illiterate inhabitants seeing Maclure, engaged in breaking the rocks with his hammer, supposed him to be a lunatic who had escaped from confinement; and on one occasion, as he drew near a public house, the inmates, being informed of his approach, took refuge indoors, and closing the entrance held a parley from the windows, until they were at length convinced that the stranger could be safely admitted. In this work he had to stand much privation and fatigue and his power of endurance he used to attribute chiefly to the undeviating simplicity of his diet "the regimen of which demanded nothing but water and a very small quantity of the most common food".

Identification with Science

This amateur geologist gave himself up entirely to science and education as he advanced in years. He became a foundation member of the Academy of Natural Sciences of Philadelphia (1812) and was its president from December 1817 to the end of his life. He personally supervised the publication of its *Journal*, provided it with a building at a cost of 20,000 dollars from his own private funds and transferred to it his private library and museum. His urge to encourage adult education was profound. He founded the New Harmony Working Men's Institute in 1838 and by his will provided for the payment of 500 dollars to any club of labourers which should establish a library of 100 volumes.

His End

Maclure spent the last years of his life in Mexico in the hope of aiding in the educational uplift of its people. In addition to the two geological maps, he published twelve papers, all on geology. His contributions on political, social and economic topics were collected and published (1837) in two volumes as *Opinions on various subjects, dedicated to the industrious producers.*

On his way from Mexico to the United States, on the serious failure of his health in 1839, he died at the village of San Angel, near the City of Mexico, March 23, 1840.

S. R. Ranganathan.

SEISMOLOGICAL NOTES FOR FEBRUARY 1940

During the month of February 1940 ten slight and one moderate shock were recorded by the Colaba seismographs as against four slight and one moderate shocks recorded during the same month in 1939. Details for February 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus (miles)	Remarks
1940		H. M. S.	(miles)			
Feb. 7	Moderate	22 36 4	5640	55°N., 178°E. (Bering Sea)	normal	
,, 8	Slight	20 45 15	1210	Hindukush mountains	125?	
,, 13	Slight	8 55 54	1270	..	..	
	Slight	17 16 25	1395	..	..	Felt severely n Shillong
	Slight	18 56 31	1250	..	..	
,, 16	Slight	6 36 46	1400	..	..	
,, 20	Slight	7 48 04	6900	In the region of New Hebrides Islands in the Pacific.	110-125	
,, 20	Slight	18 24 42	3950	..	..	
,, 22	Slight	19 0 57	3130	..	..	
,, 24	Slight	17 30 11	4890	..	..	
,, 29	Slight	21 37 46	3090	..	..	

The Colaba Observatory,
Bombay,
March 6, 1940.

ASTRONOMICAL NOTES

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T. P. B.

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The day of greatest magnetic activity was the 25th and that of least disturbance the 18th. The characters of individual days are shown in the table below:

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		Slight	Moderate
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There were no magnetic storms during the month of February 1940, while three storms (two of great intensity and one of moderate intensity) were recorded during the corresponding period of 1939. The mean character figure for the month is 0·72 as against 0·83 for February of last year.

M. R. RANGASWAMI.

The Observatory,
Bombay,
March 6, 1940.

BOARD OF SCIENTIFIC AND INDUSTRIAL RESEARCH

WE wish to tender our hearty felicitations to the Government of India on their speedy decision to set up the Board from 1st April 1940. They have secured the co-operation of a number of prominent scientists and industrialists in the country to serve as its members. The Board is to be a consultative and advisory body; its functions will be to advise the Government as to the lines on which industrial research should be conducted and the channels into which it should be guided in order to ensure the co-ordinated development of India's industries, particularly those the importance and possibilities of which, have been prominently brought into the foreground as a result of war conditions. The Board will utilise and co-ordinate the work of the existing organisations already employed in this field. The Board will also recommend to the Government what specific problems should be assigned for investigation to the staff directly under the Board on the one hand and to the various scientific and research institutions in the country including universities' laboratories on the other.

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The Commerce Member of the Government of India will be the Chairman of the Board, and the Chief Controller of Stores, India Stores Department, will be its first Vice-Chairman. The Government have been able to secure the services of Dr. Bhatnagar, Head of the Punjab University Chemical Laboratories, as Director of Scientific and Industrial Research.

INDIAN BOTANICAL SOCIETY

Some More Items of Work for the Third Decade*

RAI BAHADUR PROFESSOR K. C. MEHTA, M.Sc., PH.D. (CANTAB.), F.N.I., in his Presidential Address to the *Indian Botanical Society*, drew attention to some new activities which the Society might take up in view of its members fully representing all the important branches of *pure* as well as *applied* Botany. He suggested the organization of the following regional branches, so that through the activities of each of the local branches, the Society as a whole might serve a still more useful purpose than it has done in the past:—

(1) Bengal, Assam, Bihar and Orissa should form one branch incorporating the present Botanical Society of Bengal; (2) The United Provinces, Punjab Province, Kashmir and Sind should form another branch; and (3) Bombay, Central Provinces, Hyderabad and Madras should combine for the third branch.

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Professor Mehta also proposed that four prizes, named after four foundation members, *i.e.*, the late Dr. P. Bruhl, the late Rao Bahadur K. Rangachariar, the late Rai Bahadur Prof. S. R. Kashyap, and the late Dr. W. Dudgeon, be offered every year to writers of best essays on selected topics, preferably on subjects that each of the foundation members was specially interested in, for encouraging advanced students in writing up dissertations. For the benefit of advanced students, Dr. Mehta further proposed that it would be very desirable to publish small handbooks comprising the subject-matter of 3-6 lectures written up by the members of the Society dealing with their researches in the domain of Botany.

Y. BHARADWAJA.

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PROGRESS OF AGRICULTURAL RESEARCH IN INDIA

THE Ninth Annual Report of the Imperial Council of Agricultural Research covering the period 1st April 1938 to 31st March 1939, as usual, gives a brief account of the progress of the numerous research and other schemes carried out under the auspices of the Council. In the personnel of its officers the Council loses the services of Sir Bryce Burt, its experienced and energetic Vice-Chairman, who as the doyen of the Agricultural Service in India was an exceptionally valuable asset to the Council during the years he was connected with it. Sir Bryce Burt retired at the end of the year and at the beginning of the year his retirement was preceded by that of Col. Sir Arthur Olver who as the Council's Expert in Animal Husbandry, was able to initiate and organise the many-sided research in that important branch of agriculture to which the report bears ample testimony. In regard to research schemes practically every important crop is covered with, of course, the exception of cotton and jute which are served by separate organisations and funds; likewise animal husbandry has been embracing a gradually widening range of subjects. Nevertheless there is the feeling that the tempo in this respect has slackened somewhat and that many important schemes though considered and sanctioned have to remain on the waiting list for a very long time. Several schemes were completed in the year and some which should have come to a close have been extended for further periods. The current schemes number one hundred with a budgeted expenditure of Rs. 1,04,25,080 while those which came to a close and were not extended had a budget of Rs. 22,09,860.

Research on rice occupies an important place among the schemes and the results obtained already in the different centres are said to be of much practical value under the different local conditions. Thus the Assam schemes have led to the production of deep water rices suited to three different levels, the seeds of which were released for general distribution. Age of seedling experiments in Bengal, improved strains suited to local conditions in S. Bihar and the Central Provinces, a method of breaking dormancy in rice seed in Orissa, the use of molasses as a manure for rice in the United Provinces, fertiliser trials in all the centres may be of mention from among the year's results of this kind while on the scientific side work related to the composition of leachings from rice soils, physiological studies, water requirements, factors in the flowering of rices and so on. Fertiliser trials reveal considerable difference as between one province and another; in Bihar an application of 60 lbs. of N and 60 lbs. of P_2O_5 gave a net profit of Rs. 35 to Rs. 40 per acre; in the Central Provinces the highest net profit per acre was with 20 lbs. of P_2O_5 and amounted to only Rs. 3–12–0 per acre, while in Orissa doses of nitrogen from 20 to 40 lbs. gave increased yields which however did not pay for the cost of manure. In regard to wheat, certain methods for the control of rust have been advocated as the result of the investigations so far and these control measures are said to be under consideration for practical action. In barley several types have been sent from time to time to assess their suitability to the British market but no sample has been satisfactory in all respects; work on cholam malts was concluded in the year and methods of storing were worked out and its usefulness for infants and invalid children demonstrated. Fruit research schemes bulk largely and nearly every province and every kind of fruit is served. Among the results achieved may be singled out those relating to the cold storage schemes of Poona and of the Punjab which have been testing the suitability of different kinds of fruits and vegetables for cold storage; we look forward to useful results. While many lines of work have been taken on hand we feel that fruit pests and diseases are not receiving adequate attention; the chief and by far the most serious trouble with the fruit industry and one against which the grower feels helpless is disease and we think this should have the first claim as regards research for the devising of simple remedies. Among fibre crops sunn hemp is being studied; and the retting trials lead to some valuable practical conclusions which we hope will be tested by the actual cultivator and assessed for factory use.

Progress in research on oilseeds, including the diseases of the cocoanut trees in Travancore, on tobacco and potatoes has been slow. An officer was deputed in the year to the U.S.A. for studying the cultivation and preparation for market of tobacco, for a period of six months; two more such officers are also proposed to be sent; we think six months is too short a period for this purpose and also that the study should include the market in the U.K. in relation to supplies of Indian-grown cigarette tobacco. Soil research has related to fundamental problems; the new nitrogen fixation theories of Dhar on which much work was done are now pronounced not to be supported by experimental evidence. Much of the work in this section including that on the composition of town refuse is, we are glad to note, to be written up for publication. The dry farming researches seem generally to have yielded useful results, but in this, as well as in many other investigations, we feel that full use has not been made of work in the different departments especially of the earlier years. Sugar research continues to be the most comprehensive and enjoys the biggest budget. We are told that hereafter this work will receive a fixed proportion of the sugar excise duty realisations, amounting roughly to Rs. 11·2 lakhs per year. Very important investigations are in progress under this head; we would suggest separate short reports being issued on each of these both as interim and as final ones. The Institute of Sugar Technology admitted 19 students in the year for the various courses and 38 students completed their courses. In regard to the starting of the cultivation of cloves, action has been left to be

taken by the departments concerned, but we feel that unless some special attention is bestowed by the Council itself no satisfactory progress will be made.

The third meeting of the Animal Husbandry Wing of the Board of Agriculture was held in the year and a large variety of subjects was considered and schemes reviewed. The importance of mixed farming as an aid to fodder production was stressed and the grant of special funds from the Council to the provinces for this work was recommended. Cattle diseases like pleuro-pneumonia of goats, Johnes disease in dairy cattle, surra in horses, theileriasis of cattle, rinderpest of cattle, in goats and sheep, and Doyles disease of poultry were considered and further work on nearly all of them recommended. As a preliminary to pedigree registration the breed characteristics of seven important breeds were defined and the information was published in the year. In respect of sheep and wool, an animal nutrition scheme for Assam, investigation of poultry diseases, development of the fishing industry and apiculture and pig keeping, considerable preparatory work by the Council in the year is reported. We note that the proposal to open a Central Veterinary College for India has now been dropped. The Report contains a review of the operations of the Agricultural Marketing Officers and the Central Marketing Staff.

In addition to the three journals being published by the Council quite a large number of monographs, reports and bulletins were issued during the year. A description of crop plant characters in respect of rice and cotton, the voluminous reports on the cost of production of sugarcane and cotton, and a report on the prospects of cinchona cultivation in India may be mentioned among the large number of publications in the year. Among other activities may be mentioned an enquiry into the agricultural and veterinary needs of Coorg with a view to developing the resources of this small but important tract. The Report bears ample evidence that the Council is performing a most important function somewhat on the lines of the Federal Department of Agriculture in the U.S.A. Though fundamental problems and those of all-India application alone may be deemed to come within the sphere of the Council's activities, we cannot help thinking that the extent to which the work leads to practical results and to general adoption should be watched and suitably provided for. A. K. Y.

THE DEVELOPMENT OF GALACTIC DYNAMICS AND SOME ALLIED PROBLEMS*

THE Address deals with the dynamics of rotating configurations, and its astronomical applications. It also deals with the theories regarding the origin of the solar system.

The earliest work on the Maclaurin spheroids and pear-shaped configurations of liquid masses is first mentioned. This leads on naturally to the work of Jeans on rotating compressible masses. Of a fundamentally different nature is the work of Milne, Chandrasekhar and others on the distortion of polytropic configurations of a rotating mass in relative equilibrium. The Address deals exhaustively with the work of Chandrasekhar, Von Zeipel and Kopal in this field. Recent work, stimulated by the author of the Address himself, has generalised the results to the case where the variation of angular velocity, in specifying the polytropic configurations of a rotating gaseous model, is taken into consideration.

One of the most important applications of the theory of rotating gaseous configurations is to the explanation of the spiral arms of spiral nebulæ. Of several such theories the oldest is that of Jeans, but this theory meets with a number of objections. Later theories are due to Brown, Vogt and Lambrecht, Wellman, Jehle and the most comprehensive work is that of Lindblad. Recent investigations by Banerji, Nizamuddin and Bhatnagar appear to give reasonable conditions for the formation of spiral arms.

The last part of the Address is devoted to modern theories of the origin of the solar system. After a brief mention of the planetesimal theory of Chamberlain and Moulton, and the tidal theory of Jeans as modified by Jeffreys, the Address deals comprehensively with the binary star theory suggested by Russell. The theory of Lyttleton and objections to it by Luyten and Hill, and further modifications by Lyttleton are explained in detail. A recent suggestion of Banerji of looking at the problem as a problem of three bodies in its general aspects has enabled Bhatnagar to come to the conclusion that the result of collision would be that the components of the original binary would themselves collide. This provides another objection to Lyttleton's theory of a nature different from that pointed out by Luyten.

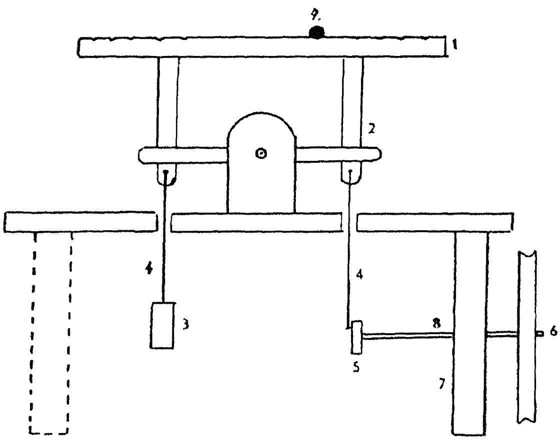
B. S. M.

* Summary of Presidential Address.—By Prof. A. C. Banerji—Mathematics Section, Indian Science Congress, Madras, 1940.

SCIENCE NOTES AND NEWS

A Mechanical Model of the Cyclotron.—Mr. F. A. B. Ward has recently described (*Proc. Phys. Soc.*, September 1939) a mechanical model illustrating the principle of the Cyclotron. One such model was made for the Madras Presidency College Centenary Physics Exhibition. Ward's model will show appreciable acceleration of the steel ball only when the disc is made of metal and friction is very small as the ball is accelerated only when it travels the ramp—a distance of one inch—and the acceleration so produced at each step is small.

The model made at the Presidency College has a wooden disc. The cutting and polishing of the grooves are hence comparatively simpler. The disc is not cut into three parts as in Ward's model but is screwed as a whole to the oscillating arms (Fig.). The tilting mechanism has been modified and the model is much simpler in design and easier to make. The speed of the motor driving the larger pulley is adjusted to give resonance.



A mechanical model of the cyclotron. Scale 1 : 4

1. Wooden disc with spiral groove. 2. Oscillating arms. 3. Restoring weight. 4. Strings. 5. Wooden pulley with a nail fixed ½ cm from centre. 6. Large pulley connected to a slow motor. 7. Central third leg. (The model has only 3 legs). 8. Shaft running through the leg. 9. Steel ball representing the ion.

This model is, however, a less exact analogue of the Cyclotron than Ward's model as the steel ball is accelerated throughout one dee instead of between the dees. But the acceleration is greater and spectacular. The model illustrates the two main principles of the Cyclotron. (1) The suitably timed reversal of potentials (here reversal of levels) and consequent addition of velocities. (2) That time of travel of an ion is independent of the length of path.

T. R. JAYARAMAN.

* * *

Weeding in Teak Plantations.—Even minor improvements in the technique of raising forest crops, reducing as they do first costs, are, apart from their scientific interest, of considerable financial value because of the long period after which the investment (with the accruing interest) can be recouped in the form of the harvested timber. Mr. A. L. Griffith, Sylviculturist, Madras, who has taken up a systematic study of the existing technique of raising teak plantations in India made a notable contribution some time back by experimentally determining the optimum size of the stumps to be used in the stump-planting of teak. He has followed this up by a well-planned critical investigation into the weeding methods in the formation of teak plantations (*Indian Forest Records*, New Series, Sylviculture, Vol. IV, No. 2). His results demonstrate (for the particular soil and climate type in which the experiments were made) the superiority of "Weeding by Scraping" over four other methods in current usage. This conclusion was drawn from significant data revealed by statistical analysis. Mr. Griffith's study in weeding could well serve as a model, both in the well-defined objective of the experiments as well as the design of the experiments, for Sylvicultural research workers in India.

EMMENNAR.

* * *

Water Content of Trees.—Forming the introductory part of his *Studies in Tree Physiology*, Dr. R. Darnley Gibbs has an interesting paper on the "Water Contents of Certain Canadian Trees" (*Canadian Journal of Research*, 1939, 17, 460). The investigation was originally started to obtain information on the seasonal changes in water content of trees. This was needed in connection with efforts to minimise the loss of logs during transport by raft flotation. Dr. Gibbs' preliminary investigation showed that (*i*) in the soft woods examined (Jack Pine, White Spruce, Balsam Fir) there is little evidence of seasonal change; (*ii*) in the case of paper Birch and Poplar there is a spring maximum of water content when the trees are practically full of water; this coincides with the swelling and breaking of the buds: (*iii*) following leaf opening there is a rapid decrease in water content, which continues until August or September; this reduces the amount of water in the tree to little more than half the spring value; (*iv*) after leaf fall the water content rises; (*v*) the distribution of water in Birch and Poplar is consistent with the tension hypothesis of the ascent of Sap; and (*vi*) girdling, as a means of reducing water content, is effective only if a complete ring of sapwood be removed.

Dr. Gibbs is continuing his investigation into other cognate problems in tree physiology.

EMMENNAR.

* * *

Study on Lettuce.—Lettuce (*Lactuca sativa*) has lately been the subject of a critical study at the *Forest Research Institute*, Dehra Dun. Dr. Stebbins, Assistant Professor of Genetics,

University of California, who made the study with the aid of specimens from the Herbarium of the *Forest Research Institute*, has re-arranged the species as known in the *Flora of British India*, and added one more species to those hitherto known. The results of the study are now published in "Notes on some Indian species of Lactuca", just brought out in the *Indian Forest Records* (New Series), Botany.

There is little connection between the lettuce as grown in gardens and its relatives of the same genus found wild in the Himalayas. Dr. Stebbins, however, draws attention to the interesting fact that all species native in the Himalayas have the basic haploid chromosome number, 8, while those which have entered India from the West have the basic number 9. The significance of this fact is not yet understood.

* * *

Measurement of Gloss, Transparency and Colour.—The details of a new apparatus for the measurement of gloss, transparency and colour, devised by Mr. N. N. Murty, of the *Indian Lac Research Institute*, appear in the recently published Bulletin, No. 37 of the Indian Lac Research Institute.

In this apparatus the source of light and the device for measuring the reflected light are located in fixed positions and subtend a right angle at the centre of the test surface which can be rotated so as to vary the angle of incidence. Measurements taken at various angles of incidence consist of light values for specularly reflected light at 45° angle of incidence and for diffused light in a direction perpendicular to the incident beam at other angles of incidence. When these are plotted against the angles of incidence, curves are obtained which have similar shape to those obtained with goniophotometers. The shape of these curves depends upon the gloss of the surface under test and can be looked upon as 'gloss pictures'.

An instrument ('Glossograph') for self-recording of such curves has been devised by directly coupling the axis of a motor-driven drum camera with that of the rotating panel of the glossometer.

The procedure for measuring the transparency of varnish films has been described; and the procedures for colour and colorimetric measurements have been indicated.

The advantages claimed for the instrument are that it combines three apparatus in one, and in measuring gloss, follows closely the procedure common to most people in the visual judgment of gloss.

* * *

Sulaiman's Predictions.—The following is the full extract of a letter dated December 11, 1939, to Sir Shah Sulaiman from Prof. A. Michailov of Moscow. Sir Shah has kindly sent it to us for publication:—

"At last I am able to give the definite results for the deflection of light observed by me during the solar eclipse of June 19, 1936. You were right in cautioning that the terms of second order can be of influence in the reduction of the plates. One of the plates showed indeed the effect of a tilt, which had to be eliminated by introducing second order terms. Moreover, an arithmetical error was detected in the preliminary result, that I quoted to you in my last letter. I obtained the following values.

"Two of the eclipse plates were measured twice with different comparison plates.

Eclipse plate	Comparison plate	Deflection
		″
No. 2	No. 5	2·44
,, 2	,, 6	2·42
,, 4	,, 5	2·85
,, 4	,, 6	2·93
Mean	..	2·72 ± 0·21 p.e.

"Of course the result is rather poor, as the nearest star to the sun's limb that could be measured was 31′ from the centre of the sun. In all only 25 stars could be measured. I must state, that your anticipation that a value much larger than Einstein's is to be expected gives me more confidence in publishing my results. In a short time a full account of the work shall go to press."

* * *

Raw Materials and Foodstuffs.—There was never a moment in history at which information about supplies and sources of raw materials and foodstuffs was more urgently and more generally sought than to-day.

The volume entitled *Raw Materials and Foodstuffs Production by Countries*, 1935–1938, which has just been published by the *League of Nations*, will meet a very real need. It brings together in a handy form information which previously could only be obtained by much research. Indeed, the volume contains the most complete statistics ever published on the production of raw materials and foodstuffs, by countries. The information relates to some 200 different commodities and nearly 140 countries or areas.

The tables are so compiled that the complete production of any country can be seen by a glance at a single page.

* * *

Co-ordination of Transport.—The League of Nations has just published an interesting addendum to the volume recently issued under the title "Co-ordination of Transport".

It contains a highly instructive summary of the particulars supplied by Governments of the ways in which they were proposing or endeavouring to solve a problem which since the rather haphazard development of the motor industry and of road transport had almost everywhere become acute.

The two companion volumes contain an account of the evolution of this vast problem up to the outbreak of the present war.

The interest of this publication is due both to the data it contains and to the fact that it covers forty countries all over the world and so gives a truly international survey of the situation.

Clove Cultivation in India.—The question of undertaking clove production in India is under consideration of the *Imperial Council of Agricultural Research* in consultation with the Governments of Madras, Travancore and Mysore.

The preliminary enquiries of the Imperial Council of Agricultural Research have shown that before clove production can be undertaken on a large scale, more knowledge is necessary, requiring a series of co-ordinated experiments in Madras, Travancore and Mysore for an adequate supply of clove seed.

Such experiments are needed on nursery practice including the raising of seedlings and the possibilities of vegetative propagation; plantation practice including transplanting, spacing in the field, care of young plants, inter-crops and inter-culture, manuring, and the taking of the first and succeeding crops; and protection of the plants in the field against pests and diseases.

The proposals under consideration include suggestions for ensuring an adequate supply of seed and seedlings for the experiments, and a general programme for the cultivation experiments keeping in mind the practical object of the experiments.

The Governments of Madras, Travancore and Mysore have been asked whether they can co-operate in the scheme, and to state what facilities in the way of land, labour and equipment they can provide, so that a suitable design of identical experiments for the three Governments can then be designed by the Agricultural Commissioner with the Government of India, in collaboration with the Directors of Agriculture concerned.

* * *

The possibility of manufacturing newsprint paper in India is indicated as a result of the successful investigations carried at the **Forest Research Institute**, Dehra Dun. Owing to difficulties of obtaining suitable raw materials for the production of mechanical pulp, the manufacture of newspaper print has not hitherto been attempted in this country. It has now been shown that suitable pulp can be obtained from *Kydia calycina* (*bendi* or *pola* wood) and by employing a mixture of 70 per cent. mechanical pulp and 30 per cent. bleached bamboo pulp, paper of satisfactory quality has been prepared on the experimental plant at the Forest Research Institute. The paper has been employed for printing *Dehra Advertiser* (Vol. 2, No. 5), with very satisfactory results. Where plentiful supplies of *Kydia calycina* are assured and cheap power available, the manufacture of newsprint and cheap printing paper is an attractive proposition. India imports annually 38,000 tons of newsprint valued at about 62 lakhs of rupees.

* * *

Reorganisation of the Institute of Plant Industry, Indore.—At its last meeting held at Coimbatore in January 1940, the *Indian Central Cotton Committee* accepted the proposals of the special Sub-Committee for reorganising the Institute, as a result of which, fundamental researches on genetics and plant physiology would be separated from the other work of the Institute and treated as a separate scheme under the direct control of the Committee. The work of the Institute which will be controlled by a Board of Governors and financed by joint contributions of member States of the Institute and the Committee, will be confined mainly to the breeding of cotton and other crops, seed multiplication and distribution, demonstration and propaganda and such agronomical and chemical work as may be considered desirable in the interests of the member States. The reorganisation will take effect from April 1, 1940.

* * *

Public Health in India.—Colonel Sir Alexander Russell's report on public health in India for the calendar year 1937 is a *compendium* on public health and deserves close study. It is divided into two volumes, Volume I being the report proper and Volume II dealing with the health of the Indian Army.

Volume I deals with the history of chief diseases, including tuberculosis and hookworm, maternity and child welfare, public health administration, fairs and festivals, adulteration of food, housing, industrial hygiene, etc., etc. Medical intelligence and international health, including those of ports and health of jails are described. Reference is also made to the work of such voluntary organisations as the *Indian Red Cross Society*, *British Empire Leprosy Association* (Indian Council), the *International Health Division of the Rockefeller Foundation*, the *Bombay Presidency Baby and Health Week Association*, the *Karachi Health Association* and the *Health Propaganda Board*, Madras.

In Section XI, forty years' progress in public health is traced under public health administrations, the *Central Advisory Board of Health*, the *All-India Institute of Hygiene and Public Health*, Rural Health, Medical Research. Nutrition, Anti-tuberculosis work, etc.

The principal vital statistics of British India for 1937 are:—

Estimated Population	272,406,436
Density per sq. mile	358
Births—	
Number	9,388,457
Rate per mille	34·5
Deaths—	
Number	6,112,375
Rate per mille	22·4
Infant Mortality for 1,000 live-births ..	161·7
Vital Index	153·6

Both the birth and death rates show slight decreases as compared with the previous year but the net result was an increase in the estimated mid-year population of over three and a quarter millions. The average annual increase in population during the seven years from 1931 to 1937 has been just short of three millions and these years have, generally speaking, been characterised throughout by freedom from violent outbreaks of epidemic diseases.

"Repeated stress has been laid in these reports on the fact that public health cannot be regarded as an entity distinct from the general, social and economic life of the community. It is, therefore, satisfactory that the advent of the provincial autonomy and the conferment of extensive powers on Provincial Governments

have been followed in many provinces by social legislation which will undoubtedly have far-reaching effects on the economic life and general well-being of the people. Agricultural indebtedness, land tenure and industrial problems, to cite a few examples, are all receiving serious attention and, in so far as legislative and administrative action in these directions goes to raise the standard of life, these measures will inevitably help in improving the state of public health. In these annual reviews of the health conditions of India, there is little room for any detailed survey of social and economic factors, but mention is made of these wider aspects of community life in order to emphasise the necessity of viewing health problems from the widest possible angle."

P. PARTHASARATHY.

* * *

All-India Institute of Hygiene and Public Health.—The Annual Report for the year 1938 makes the significant observation that although it is fully recognised that the country is badly in need of a vigorous and forward policy in regard to public health organisations, even the small number of technically trained personnel is unable to find employment in this national endeavour. Though they are keen to advance the health and efficiency of the people, the authorities find it difficult to launch extensive schemes for health protection because they are confronted with the magnitude of the problem on the one hand and the paucity of funds on the other. Most of the available funds are already appropriated by curative medicine, which as an organisation, is not only well established by tradition, but yields immediately demonstrable results, while the results of preventive medicine are difficult to demonstrate.

It is indeed pathetic to reflect that all the fine work that is being carried out at the Institute cannot be put into practice for want of funds. This is true of many of our other departments, universities and technological institutions. There is a colossal waste of intellectual effort in the country which could be harnessed in the service of the nation. Who is to harness it?

* * *

Adrenaline Preparations Sold in India.—Quite a fair proportion of Adrenaline chloride solutions sold in India is below *par* in quality and sub-standard in strength.

This conclusion has been reached by the Biochemical Standardisation Laboratory of the Government of India as a result of the study of 30 representative samples of Adrenaline chloride solution (1 in 1,000 strength) obtained through the courtesy of the Heads of the Medical Administrations all over India which have been tested biologically for their purity and potency in course of an all-India Survey of the quality of drugs and medicinal chemicals undertaken by the Laboratory.

Out of 30 samples analysed, as many as 12 specimens (or 40 per cent.) were markedly below strength (*i.e.*, less than 75 per cent. in potency of a *known standard*). Amongst this lot, 7 samples showed a strength of less than 50 per cent. Two samples apparently contained only about 10 per cent. of an adrenaline-like blood pressure raising principle. Only 9 samples (or 30 per cent.) were found to agree with the potency claimed by the manufacturers.

Adrenaline has been known to lose its strength in the presence of alkali, the deterioration being accompanied by a reddish or brownish discoloration. Excess of alkali is sometimes present in the glass of certain containers (phials, ampoules, etc.) in which adrenaline has been found stored, and it is highly probable that this factor is at least partly responsible for the deterioration of the adrenaline solutions contained. Apart from a strict watch (by biological assay conducted by technical experts) on the quality of adrenaline powders from which solutions are made, manufacturers in India who are usually dependent on the supply of glass containers from outside should, therefore, do well to test the alkalinity of glass containers before putting in solutions of adrenaline chloride.

* * *

Botanical Society of Bengal.—At the Annual Meeting held on 3rd March 1940, Professor S. P. Agharkar was elected President of the Society. Prof. S. C. Mahalanobis, Prof. S. C. Banerji, Mr. S. N. Bal and Dr. K. P. Biswas were elected Vice-Presidents. Mr. S. N. Banerji and Dr. S. M. Sircar were elected Hon. Secretaries.

* * *

India's Fish Industry.—Survey work on fish marketing under the direction of the Agricultural Marketing Adviser to the Government of India has been started in the Provinces and a report thereon is expected shortly.

Before practical measures can be taken to put the industry on a sound footing, it is necessary to carry out local surveys of the amount and class of fish available and systematic experimentation on small business scale with such improved methods of collection, transportation and handling of fish as are available in the country.

The Imperial Council of Agricultural Research has accepted schemes for the investigation of certain problems connected with the fishing industry and funds have already been provided for a small scheme for the investigation of the life-history of certain fresh-water fishes in Bengal.

A larger Madras Scheme for the development of the fishing industry has been approved, but funds are not yet available. The Orissa Government has submitted a scheme for carrying out biological investigations in the Chilka lake fishery and this was awaiting the consideration of the Council at the end of the year under review.

INDUSTRIAL NOTES

The occurrence in Kaladgi sandstones and in quartzites of Ratnagiri District and Savantvadi State, Bombay, of sand suitable for glass making has been reported by the *Geological Survey of India*. In the Vengurla-Savantvadi road, deposits of white sand, practically free from iron, have been discovered, and analysis of the sands has revealed that they satisfy some of the requirements of the glass industry.

The Geological Survey of India also reports the occurrence of (1) illeminite in small quantities in the bay, south of the port of Ratnagiri, (2) large deposits of potash felspar suitable for the ceramic industry near Kadaval in the Bombay Presidency, and (3) rich deposits of bauxite in the Baihar plateau in the Balaghat District and near Katni in the Jubbulpore District, Central Provinces.

* * *

Fatigue Strength of Crankshafts.—The Institute of Automobile Engineers, is investigating the fatigue strength in bending of crankshafts for compression-ignition engines, since bending fatigue failures have been experienced in service. The information obtained is, however, proving of value in the design of all types of crankshaft.

Three machines are in use. These machines apply reversed bending moments to the specimens, which are usually multi-throw crankshafts, one throw being broken at a time. The deflection is applied through a variable throw eccentric, and is calibrated in terms of bending moments. Failure occurs across the web, the crack starting from a fillet, and the nominal stress figure is calculated in the ordinary way from the modulus of the area of fracture. The fatigue limit is determined on a basis of ten million repetitions.

A good deal of work has been carried out on these machines to study the fatigue strength of various designs of shaft in relation to the material employed. Recently, attention has been devoted more especially to various methods of surface hardening, including nitriding, chromium-plating, etc. In addition, owing to the importance under war-time conditions of salvaging worn parts for further use, a study is being made of the effect of certain processes, such as metal-spraying, for building up crankshafts.

* * *

Indian Institute of Science, Bangalore.—In the course of his speech inaugurating the Founder's Day Celebration on the 3rd March 1940, Prof. K. Aston referred briefly to the benefits bestowed by the late Mr. J. N. Tata on the whole of India by his multifarious activities in the world of Industry and Commerce.

"The legacies he has left to the nation, the number of people for whom he has provided employment and livelihood in the manufacture of steel, cotton goods and the supply of electric power are too well known to require elaboration on this occasion, but it must be said that the magnitude of these enterprises can only inspire a feeling akin to awe in contemplating the genius of the man who was responsible for the building of, what we can now see was, the sure foundations of these organisations.

Not only was he a business genius, it is also universally acknowledged that the conception of the idea in his mind of an Institute of this nature was, at that time evidence of his vision and foresight in other directions also. This is clear from the fact that it was only some years later that similar movements were thought of in other more developed countries.

Not only do we owe to him the formulation of the idea but also the bulk of the means whereby the idea was carried into effect.

To all of us, who are privileged to work in these ideally constructed surroundings, he bequeathed an Institute of which we may well be proud and which would be the envy of many 'less blest than we', if they could but see it.

In the scope of its activities and particularly in its all-India character he has made wise provisions which are conducive to the building up of a great tradition and it should be our clear duty to devote the whole of our energies to the fostering of this tradition, however big or however small the part may be that we are called upon to play.

The Founder has provided the materials but we must do the building.

This duty is, at least in part, all pleasure. By that I mean that it is a great joy to me and to all other staff members to bring together young men from all parts of India and to see them becoming welded together into one large family."

* * *

Lucknow University.—Miss C. Virkki, M.Sc. (Lucknow), has been declared eligible to the Degree of Ph.D. (Lucknow). She presented a series of important papers on the *Glossopteris* flora, which form a significant contribution to the work engaging the attention of the Botany Department of the Lucknow University, under the guidance of Professor Birbal Sahni, F.R.S. Within the last few years, as the result of post-graduate researches in the department, several students have obtained the Ph.D. and D.Sc. Degrees.

* * *

University of Mysore.—*February* 1940: The following University Extension lectures were delivered:—(1) Mr. J. P. Das, B.A., M.Sc., A.M.I.E.E., M.I.E., Professor of Electrical Engineering, College of Engineering, Bangalore, on "The Electrical Age", in Kannada, at Dodballapur. (2) Mr. W. G. Eagleton, M.A., Professor of English, Maharaja's College, Mysore, on "The Civilisation of France", in English, at Bangalore. (3) Mr. A. Narayana Rao, M.Sc., Lecturer in Zoology, Central College, Bangalore, on "Defence in Nature", in Kannada, at Hassan and on "Biology and Human Life", at Holenarasipur. (4) Mr. D. S. Mallappa, Director, The Mysore Bank, Ltd., Tiptur, on "Social Legislation", in Kannada, at Davangere.

ANNOUNCEMENTS

New Harmone Standards for International Use.—The Third Conference on the Standardisation of Hormones, organised by the Commission on Biological Standardisation (League of Nations) dealt with the standardisation of the anterior lobe of the pituitary gland and similar principles contained during gestation in urine and blood serum.

The international standard of gonadotrophic hormone, extracted from the human urine of pregnancy, established last year by the Standards Department of the Institute for Medical Research of Hampstead (London), has already been distributed by that Department for international use. Two new standards are now ready for delivery: the lactogenic hormone

of the anterior lobe of the pituitary gland and the gonadotrophic hormone extracted from the urine of pregnant mares.

The Biochemical Standardisation Laboratory, Calcutta, which has been appointed by the Government of India as a "National Centre" for the distribution of standard preparations of biological products holds these standards on behalf of the *League of Nations* and sends them on request, free of charge, to any *bona fide* research institution or commercial organisation. The Laboratory also gives all relevant information regarding the standards to those who are interested in their use.

Scripta Mathematica has available for *free* distribution a portrait of Pythagoras reproduced from a fresco by Raphael, also a beautifully printed biography of Pythagoras by Professor Cassius Jackson Keyser (reprinted from his *Portraits of Famous Philosophers who were also Mathematicians*). These may be obtained by writing to *Scripta Mathematica*, Yeshiva College, 186th Street and Amsterdam Avenue, New York City and enclosing 10 cents for postage.

Indian Central Cotton Committee.—The next triennial Conference of Scientific Workers on Cotton will be held at Surat in January 1941.

Enzymologia.—It is announced that from Volume VII onwards the *Journal* will also take up the border zones of pure enzymology, namely, all biocatalysts; *e.g.*, besides the enzymes proper, chlorophylls, vitazymes, hormozymes (animal and plant), toxozymes, viruses, organizers, genes, etc. Only experimental papers of chemical or biological content can be accepted, not pure pathological or clinical work.

Uses and Applications of Chemicals and Related Compounds.—In the review appearing in the February issue of this *Journal* (page 82) the sentence commencing with "Sales executives, research directors" and ending with the word "available" has suffered in grammar and meaning for which the author is not responsible. His statement is now reproduced.

"Sales executives, research directors, manufacturers, dealers and others, who are naturally interested in the present-day uses of the several chemical products, each from his respective point of view, and who would have found it difficult hitherto to obtain the required information from the much scattered published literature, have now the advantage of consulting a single book which contains all the necessary references."

Biological Control in the Lac Industry.—Our attention has been drawn to a statement occurring in a note on this subject (*Curr. Sci.*, 1939, 8, 537) to which Messrs. Glover and Gupta, on whose contribution the comment is made, have objected. The statement runs thus: "The emphatic statement that the damage done by parasites is small (4·8 per cent.) may be questioned by other experienced workers in the field, whose work as is customary with these authors, has been ignored. They refer to the 'recently discovered egg parasites of lac predators' the practical demonstration of whose effectiveness will be awaited with keen interest". The two sentences are in our judgment perfectly fair, except perhaps the adjectival clause in the first which may be considered offensive by hypersensitive authors. Our reviewer at the time he wrote them, it is understood, relied on certain impressions lurking in his mind and was not aware that any damage to the reputation of the authors for their integrity would be involved. The appearance of the objectionable clause is, however, regretted and it is withdrawn. We trust that Messrs. Glover and Gupta will accept our explanation in the spirit in which it is offered.

The attention of our readers is drawn to an advertisement appearing in the February number of *Current Science*, inviting applications from duly qualified chemists for the post of Works Superintendent, The Mysore Chemicals & Fertilisers, Ltd. Applications should reach the Secretary, The Mysore Chemicals & Fertilisers, Ltd., 1128, Vani Vilas Road, Mysore, on or before the 31st March 1940.

* * *

We acknowledge with thanks receipt of the following:—

"Journal of Agricultural Research," Vol. 59, No. 8.

"Agricultural Gazette of New South Wales," Vol. 51, Pt. 2.

"Journal of the Royal Society of Arts," Vol. 88, Nos. 4545–51.

"The Philippine Agriculturist," Vol. 27, No. 9.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 31, No. 1.

"Nagpur Agricultural College Magazine," Vol. 14, No. 3.

"Indian Journal of Agricultural Science," Vol. 9, Pt. 6 and Vol. 10 Pt. 1.

"L'Agricultura Coloniale," Vol. 33, Nos. 11 and 12.

"Allahabad Farmer," Vol. 14, No. 1.

"Biochemical Journal," Vol. 33, No. 12.

"Journal of the Institute of Brewing," Vol. 46, Nos. 1 and 2.

"Journal of Chemical Physics," Vol. 7, No. 12 and Vol. 8, No. 1.

"Journal of the Indian Chemical Society," Vol. 16, No. 12.

"Journal de chimie physique," Vol. 36, Nos. 10–12.

"Comptes Rendus (Doklady)," Vol. 25, Nos. 6–8.

"Indian Forester," Vol. 46, No. 2.

"Transactions of the Faraday Society," Vol. 36, Nos. 225 and 226.

"Review of Applied Mycology," Vol. 19, No. 1.

"Indian Medical Gazette," Vol. 75, No. 2.

"Nature," Vol. 145, Nos. 3663–67.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

February 1940. SECTION A.—S. S. PILLAI: *On m Consecutive Integers—II.* V. SEETHARAMAN: *Methods of Generating Differential Invariants with Special Reference to Path-Spaces of Order 2.* T. M. K. NEDUNGADI: *Effect of Temperature on the Raman Spectrum of Quartz.* The lines are observed to broaden and shift to lower frequencies as the temperature of the crystal is raised over the range from liquid air temperature to 530° C. The line 207 broadens in an unsymmetrical and exceptionally enormous manner as the transition temperature 575° C. is approached. It is possible that this mode of vibration is responsible for the transition itself. SIKHIBHUSHAN DUTT AND B. M. S. AGARWAL: *Colour in Relation to Chemical Constitution of the Organic Salts and Metallic Derivatives of Isonitroso-Diphenyl-Thiohydantoin.* The change in colour of the above compound in the presence of alkali has been studied. This has been shown to be due to a fundamental change in the constitution of the molecules from an oximinoketonic to a nitrosoenolic form. P. R. SUBBARAMAN AND K. R. KRISHNASWAMI: *A Rapid Volumetric Method for Estimation of Iron and Titanium and its Application to Ilmenite Analysis.* Titration is effected with solutions of (*a*) ferric sulphate and (*b*) potassium permanganate. N. JAYARAMAN: *A Chemical and Mineralogical Study of the Feldspars from the Mica-Pegmatites of Nellore, Madras.* The feldspars could be grouped as non-perthitic, perthite-microperthite, and microperthite. There is mutual solubility, although to a limited extent, between the soda and potash feldspars and between soda feldspar and anorthite. The colour of these feldspars is not schiller colour but due to an iron compound.

February 1940. SECTION B.—JAI CHAND LUTHRA AND INDAR SINGH CHIMA: *Some studies on the metabolism and growth of Malta oranges.* PRAHLAD NARAIN MATHUR: *The venous system of the pond-turtle,* Lissemys punctata (Bonnaterre). S. B. KAUSIK: *A contribution to the embryology of* Enalus acoroides (*L. fil.*), *Steud.* M. ANANTASWAMY RAU: *An embryological study of* Suriana maritima *Linn.* D. SRINIVASACHAR: *Embryological studies of some members of Rhamnaceæ.*

Indian Association for the Cultivation of Science (*Proceedings*):

November 1939.—HAZARILAL GUPTA AND ABINASH CHANDRA: *Evaporation from earthen jugs.* SH. NAWAZISH ALI: *Absorption spectra of compounds of phosphorus.* F. C. AULUCK: *Linear extension of reflected image produced by a surface traversed by waves.* P. C. MAHANTI AND A. K. SEN GUPTA: *Isotope effect in Band Spectrum of tin monoxide.* SACHINDRA MOHAN MITRA: *On the polarised fluorescence of organic compounds.*

Mining, Geological and Metallurgical Institute of India:

December 1939.—A paper of great industrial importance dealing with the possibilities of manufacturing Carbon Electrodes in India by Dr. D. Swarup, Mr. V. G. Iyer, and Mr. A. H. K. Iyer, appears in the *Transactions* of the Institute (Vol. 35, No. 3). After giving a brief introduction regarding the nature of the raw materials required, the authors have investigated the possible sources of these materials in India, and their use in the manufacture of the different types of electrodes. A detailed description is then given of the several processes involved in this work, together with estimates of probable cost. At the conclusion of the paper, there is the Report of a valuable discussion on the several points raised by the authors in the course of their communication, which serves to draw our attention to other aspects of the problem.

The *Journal* also contains a paper on "The correlation of the Satpukuria Seam in the Raniganj coal-field" by Mr. M. M. Mukherji, on which Mr. E. R. Gee contributes a valuable Note.

Society of Biological Chemists, India:

January 30, 1940.—C. V. GANAPATI: *Coagulation of Milk by Enzymes.*

February 9, 1940.—DR. B. ANANTHASWAMY RAO: *Biological Methods of Malaria Control.*

March 4, 1940.—P. L. N. RAO: *Chemotherapy of Selenium and Tellurium Compounds.* P. R. VENKATARAMAN: *Water-soluble Nitrogen of Garlic* (Allium sativum). C. V. GANAPATI: *Nature of the Milk-clotting Enzyme in Papain.*

Entomological Society of India (Bengal Branch):

February 15, 1940.—D. P. RAICHOUDHURY AND DINESH CH. SARKAR: *Determination of the percentage of mortality in Bengal silk worm* Bombyx mori *L.* (*Nistid variety*) *and the effect of seasonal changes.* The author dwells on the effect of temperature and humidity as recorded by maxima and minima thermometers and dry and wet bulb thermometers day to day throughout one year. The observations were made on the larvæ reared in the laboratory from disease-free and healthy moths. The authors concluded that high temperature was inimical to the growth of the silk worm at the last larval stage when the highest mortality occurred.

Meteorological Office Colloquium, Poona:

December 19, 1939.—DR. A. L. NARAYAN: *A new photo-electric micro-photometer for the measurement of the contours of spectral lines.*

February 13, 1940.—C. W. B. NORMAND: *The International Meteorological Meetings at Berlin in June* 1939.

February 20, 1940.—N. K. SUR: *The results of sounding balloon ascents during a depression in July* 1937.

329-40—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science" Ban...

CURRENT SCIENCE

Vol. IX] APRIL 1940 [No. 4

A BUREAU OF STANDARDS FOR INDIA

I

THE need of setting up recognised standards for general convenience in scientific and technical fields was first recognised towards the end of the last century. Standardization was then applied in a limited field and was principally intended to secure accuracy and uniformity in units of measurement and other scientific data. The Bureau International Des Poids et Measures was the first to be inaugurated in 1875 for the purpose by the French Government; the National Physical Laboratory was established in 1889; and the American National Bureau in 1901. In the early stages these institutions served the interests of scientists and engineers who required standardization for purposes of co-relation or discussion and interpretation of scientific and technical data and information. With the increasing recognition of the application of science to industry, the importance of these institutions increased. Also the process of standardization or scientific reduction to well-conceived fundamentals found greater scope in industry, which was accelerated by the economic pressure and competition amongst the manufacturing countries who were keenly appreciative of the unique facilities offered and the economy secured by standardization. Within a decade since the end of the war, no less than twenty-one standardizing bodies were formed in different

countries. To-day this movement has assumed such proportions and importance, that its use can no longer be overlooked by any country that hopes to make a mark in the industrial or scientific field.

The field covered by the subject falls into the two well-defined groups: (*a*) Fundamental or absolute standardization dealing with standardization of units of measurements and allied subjects; (*b*) Industrial standardization with simplification and uniformisation of materials and methods in all branches of industry.

Fundamental standardization, in fact, constitutes an essential part of industrial standardization since the latter cannot be carried out without establishing uniformity and accuracy of units of measurement. But the classification is desirable on account of (1) industrial standards, like scientific hypotheses, only represent the present state of knowledge as applied to industry and are liable to changes and modifications with an advance in technical knowledge and skill. The absolute standards, on the other hand, change less frequently and take into cognisance not only the exigencies in promoting trade and industry but also the progress of the fundamental sciences. (2) The methods employed and outlook adopted in carrying out prolonged, patient and intricate research for establishing and improving fundamental standards, are different from those which determine the preparation of industrial standards. A committee entrusted with fundamental research will find it difficult to issue recommendations until their work is completed to their satisfaction whereas a committee like the British Standards Association, is obliged to accept the industrial point of view and adopt a policy of expediency to meet the immediate requirements of the Industry. (3) Very few industries are, in particular, interested in establishment of general standards or in research of a fundamental character since they are considered to fall beyond the scope of their routine existence. Yet, their influence on the progress of science, the integrity of trade and the advancement of industry are so intimate and effective that they are entitled to the same treatment at the hands of government as is extended to the other services of public utility. (4) The problem of choosing, maintaining or developing primary units and methods in science has grown so wide and so internationally interdependent, that it can no longer be handled in a narrow and restricted way. All the international standardizing bodies like the International Bureau of Weights and Measures, are formed by the co-operation of various governments without whose help and authority they cannot usefully function.

Fundamental standardization includes (*i*) Determination of natural or fundamental constants, *i.e.*, the data regarding the fixed points or quantities in science which constitute the basis of all pure and applied research. Physical constants such as mechanical equivalent of heat, light, electricity, specific densities, atomic weights, heat of combustion and many similar constants, have to be fixed experimentally with great precision. (*ii*) Development, construction and maintenance for purposes of reference, primary and derived standards of measurements which include all essential measurements for expressing quantitatively time, matter, space and energy and their interrelations. (*iii*) Establishment of standard scientific practices. This would involve

such work as for instance, deciding upon proper nomenclatures, definitions of scientific terms, symbols for quantities used, etc., and giving publicity to these so as to inform all those interested in the work.

We can hardly over emphasize the value of such work to science. It builds up a great amount of essential scientific data which serves as basis for experimental science; facilitates a comparative study of the data obtained by various workers in a given field; introduces precision in science and technology and helps to calibrate apparatus and instruments. It secures uniformity of practice in industry and promotes equity and justice in trade. It helps to standardize industrial processes and manufactures and to introduce accuracy and efficiency in their production.

At present every institution or industry in India that requires precision in its measurements is obliged to maintain its own standards for reference in every work. These have to be calibrated from abroad and the process has to be repeated periodically for checking the accuracy of standards so maintained. These calibrated standards or in fact any piece of apparatus imported from abroad is calibrated under conditions not obtainable in India. Difficulty therefore arises regarding reducing these calibrations to Indian laboratory conditions; it is time this country decides upon its own measurement units. The units and measures followed in this country for scientific or technical purposes are mostly borrowed from the West, and these are not directly related to the non-standardized commercial units in vogue in various parts of the country. Further the units of mass, length, volume, etc., are numerous and vary widely in different parts of the country, and often in various trades in the same locality. An attempt at standardizing these national units or nationalise the foreign ones as may be found necessary should be made. The question bears great importance both to science and industry in the country and is likely to involve a considerable amount of intricate and controversial argument.

The suggestion that India also should establish its own standards laboratory was made in 1930 by the Imperial Conference at which the Conference of Standardization was held. It was also suggested that each standards laboratory in the empire should take up research so that fundamental standards could be ultimately referred to the natural standards such as the wavelength of light, and that co-operation should exist in the working of these laboratories. A year later the Sewell Committee appointed by the Government of India to review the working of the Indian Institute of Science, Bangalore, suggested that "there should be no difficulty in obtaining recognition for the Institute as a standardization and testing laboratory if its activities and aims are sufficiently well known and various governments are approached. One such recognition has been obtained. We might, for instance, mention electrolysis, instrument calibration, investigation of surges due to switching and lightning on transmission lines, heating of cables, tests of grounds, insulators and machinery, studies of inductive intereference between power and telephone lines as some of the work which the Institute should be well able to undertake". Since the recommendation was made facilities for new channels of work in this direction are opened by the addition of Department of

Physics and of Chemical Engineering. Also equipment for a standards laboratory is being built up in the Department of Electrical Technology. We think it would be worthwhile comparing the present organization of the Institute with that of the National Physical Laboratory, as the Sewell Committee had done ten years ago.

N. P. L. (England)	*Indian Institute of Science (India)*
1. Physics: Dealing with general physics, determination of physical constants, calibration of physical apparatus, standardization of X-ray and radium.	1. Department of Physics and Department of Pure and Applied Chemistry dealing with Research in pure and applied sciences.
2. Electricity: Dealing with calibration of instruments, research on wireless transmission and electrotechnics.	2. Department of Electrical Technology including (1) communication engineering section, (2) standards room equipment dealing with training and research in electrotechnics and communication engineering and calibration of instruments.
3. Engineering: Dealing with strength of materials.	3. Department of Electrical Technology and its section of mechanical engineering. Also Central Workshop.
4. Metrology: Standardization of weights and measures, clocks, meters, etc.	
5. Metallurgy.	5. Department of Inorganic Chemistry and Department of Chemical Technology.
6. Aerodynamics.	
7. Investigation of ships.	

The idea of starting such a standards laboratory in India is not a new one. Nor will there be much difference of opinion about its disirability, a modest beginning can be made with available resources. It would be interesting to note here that the National Bureau of Standards (U.S.A.) which is the biggest standards organization in the world to-day started in 1901 with a staff of 14 technical men and 9 non-technical men. What is needed in the project is the initiative and a will to work up the idea in spite of apparent difficulties.

CUSTOMS DUTY ON LABORATORY WARE AND SCIENTIFIC INSTRUMENTS

THE Government of India imposes a customs duty of thirty per cent. on laboratory ware and scientific instruments. Whatever may have been the considerations which have led the Government to arrive at this high percentage, we wish to invite their attention to the present attitude taken by the British Government with regard to the import of goods into the United Kingdom for scientific use. On 8th September 1939, the treasury gave notice that they would consider applications for licences to import *free of duty* goods intended to be used in scientific research. The announcement proceeds to advise that such applications which should be addressed to the Secretary, H. M. Treasury, must be made on behalf of educational institutions, hospitals or recognised scientific bodies, including laboratories maintained by individual organisations or consultants, and must be accompanied by a written statement by the responsible professor or director. This statement should indicate the scientific purpose for which the goods are required and justify the claim that a suitable alternative is not obtainable in the United Kingdom. We hope that the Government of India, who have recently adopted a vigorous policy to encourage scientific and industrial research in this country, will consider the question of granting similar concessions for the importation of scientific equipment so essential for the advancement of scientific and industrial research.

A NEW X-RAY EFFECT

BY

SIR C. V. RAMAN AND DR. P. NILAKANTAN

THE discovery by Laue in 1912 of the diffraction of X-rays by crystals and the discovery by A. H. Compton in 1922 of the change of wave-length in X-ray scattering had both a profound influence on our concepts of the nature of X-radiation. Laue's discovery established beyond all question that X-rays are physically of the same nature as ordinary light but of much shorter wave-length, while the Compton effect showed in the clearest possible way that the interaction between X-rays and matter obeys quantum mechanical principles. The new X-ray phenomenon described and illustrated in the present communication has, in its physical nature, something in common with both the Laue and the Compton effects: it is a specular reflection of X-rays by crystals but with a change of frequency explicable only on quantum mechanical principles. Before proceeding to give particulars of the phenomenon, it would appear desirable to make a few prefatory remarks regarding the structure of crystals and the nature of their internal vibrations.

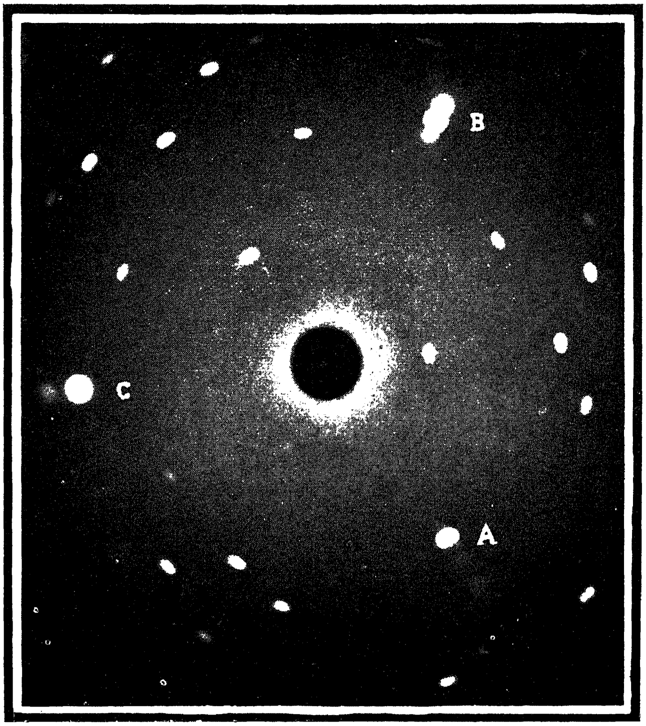


FIG. 1. Laue pattern of diamond showing the new effect

The ideal crystal is an ordered geometric arrangement of atoms or molecules held together in a space-lattice by interatomic forces. The electron density in such a crystal is a periodic function in space expressible as a three-dimensional Fourier series. Each term in this Fourier expansion contains as a multiplying factor the structure-amplitude which is the magnitude of the periodic variations of electron-density occurring as we proceed along the particular direction in the crystal. This same factor determines the amplitude and phase of X-rays reflected by the particular spacing in the crystal in the conditions indicated by the Bragg formula.

The internal vibrations possible in a crystal are of two types. The first type is the acoustic spectrum of elastic waves which traverse the crystal in all directions and range in frequency from zero up to a certain limiting value; these figure in the Debye expression for the specific heat of the solid. The second type consists of the characteristic vibrations of the crystal giving rise to well-defined spectral lines in infra-red absorption or in the scattering of monochromatic light; these appear as Einstein functions in the expression for the specific heat. We are here particularly concerned with the nature of the internal disturbances in the crystal corresponding to the Einstein functions. It would be wrong to identify them with incoherent vibrations of the individual atoms or molecules in the lattice. Indeed, in a perfect crystal, the correct way to picture them would be to regard them as a vibration of the inter-penetrating lattices forming the crystal as rigid wholes relatively to each other, so that the phase of such vibration is the same everywhere throughout the crystal.

Since the structure-amplitude corresponding to any particular spacing in the crystal depends on the positions of the atoms in the unit cell of the lattice, it is clear that a periodic vibration of the inter-penetrating lattices would cause a corresponding variation with time of each structure-amplitude. If, therefore, the crystal is traversed by a beam of monochromatic X-rays, the Bragg reflections (where these are possible) would also be affected by the periodic variation of structure-amplitude. Viewed in a classical way, this would mean that the intensity of the Bragg reflection, instead of being constant with time, would be modulated by the infra-red frequency. In other words, if the X-ray reflections could be analysed by a spectroscope of sufficiently high resolving power, we would find three components, one having the original frequency of the incident monochromatic X-radiation, and the other two, a frequency greater and less respectively than this frequency by that of the internal vibration in the crystal.

The foregoing classical view-point, though it serves to indicate the possibility of X-ray reflections with altered frequency, is fundamentally inadequate. As in the case of the scattering of light with change of frequency, it fails to tell us exactly what we do observe. For instance, on the classical theory, reflections with relatively large changes of frequency could not occur, as the corresponding lattice vibrations would not be thermally excited to any appreciable extent. On the principles of the quantum theory, however, the position would be different; the lattice-vibration, even when of high frequency and therefore not initially present, would be excited by the incidence of the X-ray itself. The intensity of the reflection with change of frequency would in fact depend on the change of structure-amplitude as indicated by the classical considerations, but the law of temperature variation would be altogether different.

The quantum view-point also indicates that we may expect to be able to observe the modified reflections independently of the unmodified ones, instead of merely accompanying them as is indicated by the classical considerations. To appreciate why this is the case, we have only to recall that the reflection of the usual type cannot occur if the spacing in the crystal, the angle of incidence and the wave-length of the incident monochromatic X-rays do not satisfy the Bragg formula. The modified X-ray reflections are, however, not determined by the fixed positions of the atoms in the crystal, but by their displacements from the same. By a suitable adjustment of the phases of these displacements, the planes of constant phase may be inclined at an angle to the crystal spacings in such manner as to satisfy the Bragg relation for the modified reflections. In other words, we would get a modified reflection from a given set of crystal planes even if when an unmodified one is not possible with the given X-ray wave-length.

Modified X-ray reflections of the kind discussed above are to be seen in Fig. 1 which is a Laue photograph obtained with a crystal of diamond, the X-rays being from a tube with copper target excited at 41,000 volts. The crystal plate which had its faces parallel to one of the octahedral cleavages of diamond was so set that the incident X-ray beam was nearly normal to the crystal faces. The white radiation present gives the usual Laue spots, the pattern exhibiting approximate trigonal symmetry. The three most intense spots in the pattern (marked A, B, C in the figure) are the reflections from the [111] planes parallel to the three other octahedral cleavages of the diamond. It will be noticed that these spots are accompanied by companions which lie on the radial lines joining them with the centre of the pattern, the positions and intensities of the companions being however different. Spot A has two faint companions lying outside. Spot B has also two companions lying one on either side of it, while spot C coincides with the inner one of its own companions. These companions are the modified reflections of the Cu K_α and Cu K_β radiations, and the spacing of the planes responsible for them is the same as that of the [111] planes in the crystal, though of course, their inclination to the incident beam is different, as explained above. The striking variation in the intensity of the spots is evident in the picture and is clearly related to their position relatively to the [111] Laue reflections. In fact, the intensity of the modified reflection is seen to fall off rapidly with the increasing inclination of the phase-waves to the [111] spacings.

The case of the diamond is of exceptional interest, both because of the fact that it approaches closely to an ideal crystal, and also because of the simplicity of its crystal

structure which consists of two similar interpenetrating lattices. The frequency of the vibration of these two lattices relatively to each other is known from studies on light-scattering in diamond to have the high value of 1332 cm.$^{-1}$ in spectroscopic units or in absolute measure, 40×10^{12} per second. It will be seen on examining a crystal model of diamond that an oscillation of the two lattices relatively to each other would cause a large variation of the structure-amplitude of the crystal for the [111] spacings. The frequency of the vibration is so high that at the ordinary temperature its thermal excitation is negligible. The fact that the modified reflections are as intense as they are is thus explicable only on the quantum point of view.

In addition to the modified reflections, Fig. 1 shows other features of great interest, *e.g.*, a diffuse halo falling off in intensity as the [111] reflections are approached and faint streamers stretching out obliquely from the modified reflections. Into the explanation of these features, we shall not here enter.

THE SEVERE MAGNETIC STORM OF MARCH 24, 1940

BY

M. R. RANGASWAMI AND N. C. BASU

(*Colaba Observatory, Bombay*)

A VERY violent magnetic storm was recorded by the magnetographs at the Alibag Observatory from 13^h 50^m G.M.T., on March 24, 1940. The duration of the storm was about 27 hours. In point of intensity, this appears to be the severest of all the storms recorded during the last 70 years. The only storms that approach the present one in severity are those of 13th May 1921, 7th July 1928, and 16th April 1938. In Fig. 1 are reproduced the Horizontal force and Declination magnetograms of the severe storm of March 24, 1940, as recorded by the Alibag instruments. The vertical force trace is unfortunately very faint and cannot be reproduced satisfactorily.

During the course of this storm considerable dislocation of telegraph traffic was observed by the Indian Telegraph Department in all their circuits. According to Reuter's news report, similar disturbance to telegraphic transmission was experienced all over the world. The storm played havoc with radio and cable communications in England. In New Zealand, the radio station could not re-broadcast the news broadcast from Britain. The most intense period of the storm as seen from the Alibag records was between 15^h 45^m and 19^h 3^m on the 24th March and the Reuter's report says that the United States suffered most severely during this period of the storm and that communications with Europe and South America were crippled for about five hours. The telephone and teleprinter circuits were also put out of action. Britain's overseas radio and cable communications were severely interrupted.

A few days prior to the severe storm there was a gorgeous display of Aurora Borealis as far south as Bulgaria and also at Bologna in Italy. Aurora Australis is reported to have been observed in the southern hemisphere. No unusual activity on the sun was, however, noticed till March 24, the day of the severe storm, when seven large spots were reported to have been seen on the sun at the Heyden Planetarium, United States.

The Solar Physics Observatory at Kodaikanal, on the other hand, observed a large sun-spot group approaching the central meridian on the morning of March 25, when the storm was still in progress. No other special solar activity was noticed at Kodaikanal but the surrounding flocculus showed some bright points.

An examination of the magnetograms shows that practically quiet conditions prevailed from $20 \cdot 5^h$ on March 20 to 6 hours on March 23. At 6^h 17^m on the 23rd, however, a moderate disturbance began with a marked "sudden commencement" and continued till 13^h 50^m on March 24, when the violent storm commenced.

Characteristics of the Storm

The storm began at 13^h 50^m G.M.T., on March 24, 1940, with a sudden increase of 62 gammas in H, a change of $1 \cdot 3'$ westerly in D and a fall of 10 gammas in Z. 15^h 45^m on March 24, marked the beginning of the most violent period of the storm. At

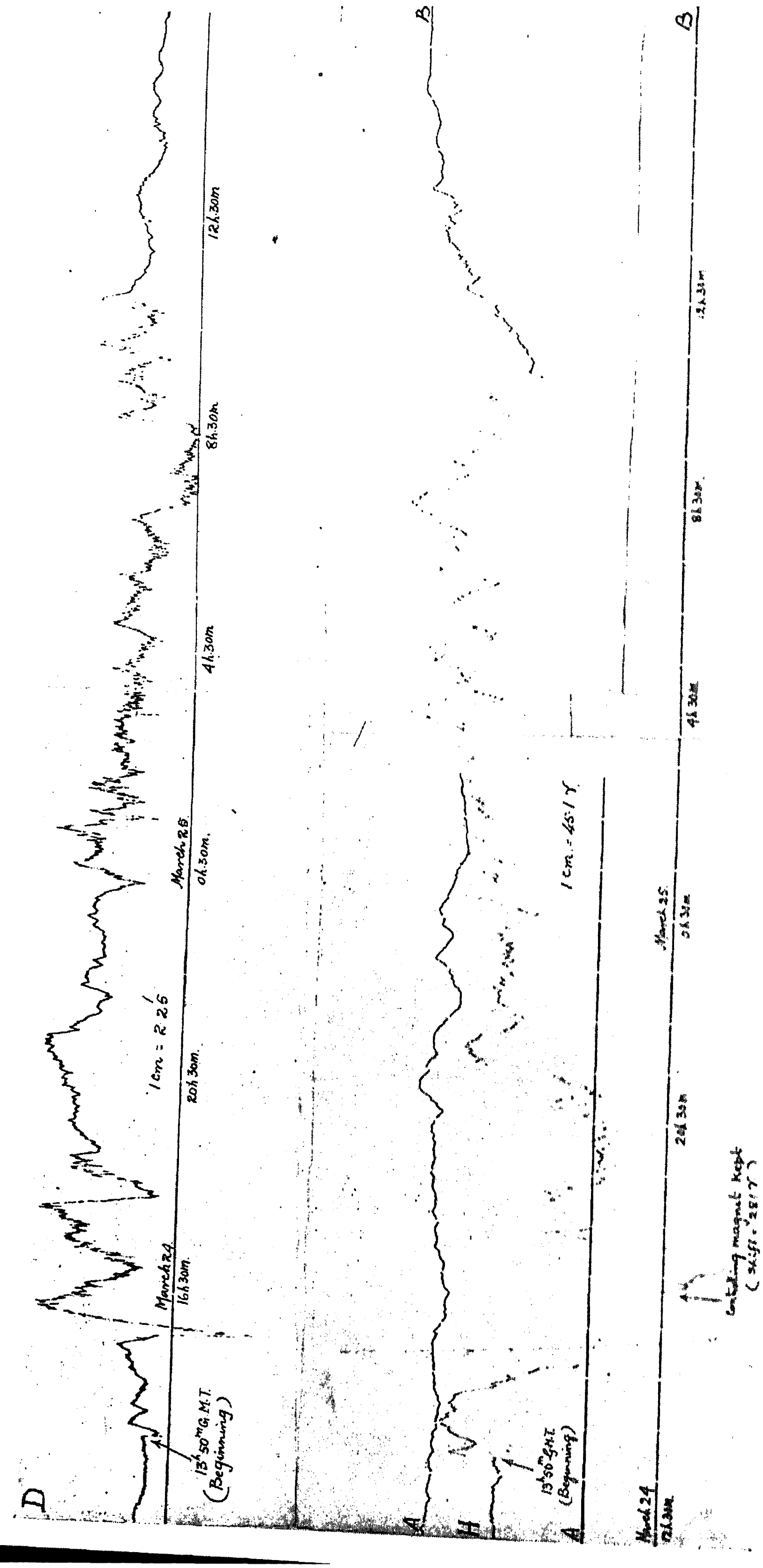


FIG. 1

The Severe Magnetic Storm of March 24, 1940, recorded at Alibag

this time, H and westerly D rose suddenly by 321 gammas and 8·3′ respectively. The sudden rise of 321 gammas in H is so far the largest value of any instantaneous rise in H recorded at Alibag. Reaching its maximum value at 15^h 46^m H experienced a very sudden fall of 500 gammas in 36 minutes. At 16^h 33^m it fell so rapidly that it immediately went off the recording limit of the photogram causing a loss of record between 16^h 33^m and 17^h 8^m. Later on H was brought within the field by the use of a controlling magnet which shifted the trace by 281 gammas. After 32 minutes H fell further and the light speck was off the recording sheet again from 17^h 40^m to 18^h 4^m, in spite of the controlling magnet. During this interval H attained its minimum. Though the actual value of the range cannot be determined due to the loss of the minimum outside the magnetogram, it is believed to exceed 785 gammas by a fair amount. The H range in this storm is the highest so far recorded at Alibag. The ranges in D and Z were 17 minutes and >100 gammas respectively but these limits have been exceeded on some previous occasions. Pronounced oscillations in H continued between 18^h 18^m and 19^h 18^m, when they became feebler. At 21^h 4^m, H rose with fluctuations till 21^h 56^m when it fell. Minor fluctuations continued till 0^h 3^m on March 25, when disturbed conditions reappeared and continued till 11^h 6^m after which a gradual return to pre-stormy conditions commenced. The storm ended at about $18{\cdot}5^h$ on March 25, 1940.

PALÆOBOTANY IN INDIA

THE study of palæobotany in India on modern lines may be said to have begun in the year 1921 when Prof. Birbal Sahni, on his return to India after a distinguished career at Cambridge, started the Lucknow School of Palæobotanical Research. Due to his unbounded enthusiasm and under his able direction the study of palæobotany soon made rapid strides, with the result that during these 20 years not only has an enormous amount of valuable palæobotanical work been done by himself and his co-workers at Lucknow, but our interest in the study of fossil plants has been so successfully revived and stimulated that quite a number of other centres of palæobotanical research have come into existence in different parts of the country; and the total number of papers published year after year is rapidly on the increase. There has thus arisen the need for a suitable body to co-ordinate these activities, and we are glad to find that Prof. Sahni himself has taken the lead in the matter and has arranged to publish hereafter annual reports of the progress of palæobotanical studies in India; and in this task, he will be assisted by a committee composed of all the important workers in this field in India.

From a perusal of the first number of the Progress Report which is now before us, we are struck by the large number and variety of palæobotanical investigations now being pursued in India. As is only naturally expected, a large portion of this work is being done by Prof. Sahni himself and his co-workers at Lucknow—Miss C. Virkki, R. V. Sitholey, K. Jacob, A. R. Rao and others—resulting in most valuable contributions to our knowledge of fossil floras in India, the importance of which has secured world-wide recognition.

The discovery in 1931 by Prof. L. Rama Rao (Bangalore) of fossil algæ in the Cretaceous rocks of South India revealed a new field of palæobotanical research in India, and from the Report now under review, it is seen that Prof. Rama Rao and his co-workers S. R. Narayana Rao and K. Sripada Rao have been making extensive and valuable contributions in this field. The rich algal flora which they have recently discovered in the Eocene beds of the Salt Range has provided a new wealth of material for study of great interest both from the stratigraphical and palæobotanical points of view.

A valuable collection of fossil plants from the Pleistocene Karewas of Kashmir recently made by de Terra, is being described by Mr. G. S. Puri (Amritsar). Over 90 species belonging to 48 genera and 24 families have already been determined, nearly all of them being similar to modern forms living in parts of Kashmir.

We welcome the Report as a most valuable publication and we have no doubt that under the inspiring leadership of Prof. Sahni, the study of palæobotany has a great future in this country.

Prof. K. S. KRISHNAN, D.Sc., F.R.S.

KARIAMANIKKAM SRINIVASA KRISHNAN who has recently been elected by the Royal Society of London to its Fellowship was born at Watrap in South India on the 4th of December 1898. His early education was at the Hindu High School, Srivilliputtur and the American College, Madura. Later, he was at the Christian College, Madras and the University College of Science, Calcutta. He started his career as a demonstrator in chemistry at the Christian College, Madras, but did not continue long in this comparatively unproductive occupation. His search for a suitable place which offered sufficient scope for research work led him to the *Indian Association for the Cultivation of Science at Calcutta* where he came into contact with Prof. Raman. The latter was then leading an active school of research at Calcutta, and Krishnan enlisted himself as a research scholar under his guidance in November 1923. After staying there for a period of about five years, during which time he exhibited an extraordinary capacity for original work in several branches of physics, Krishnan was appointed Reader in Physics at the *Dacca University*. He held this post from the end of 1928 to the middle of 1933. During this period, he initiated independent lines of work and consequently a number of enthusiastic students gathered round him. In 1933, when Prof. Raman had to leave Calcutta to take up his duties at Bangalore, Krishnan was called upon by Prof. Raman who was then the Honorary Secretary of the *Indian Association for the Cultivation of Science*, to take up the newly founded Mahendra Lal Sircar Research Professorship in Physics at the Association. Krishnan accepted the offer and has since then been occupying this chair. His election to the Fellowship of the Royal Society is a well-deserved distinction and constitutes an expected landmark in the career of so distinguished a researcher as Krishnan. This is not only a fitting tribute to the memory of the late Dr. Mahendra Lal Sircar but also speaks volumes for the foresight of Prof. Raman who was responsible for creating the Mahendra Lal Sircar Professorship and inviting Krishnan to accept the same.

Krishnan is the author of numerous original papers dealing with a variety of subjects such as magnetism, optics and crystallography. During the period of his stay as a Research Associate at the *Indian Association for the Cultivation of Science*, he collaborated with Prof. Raman in extensive theoretical and experimental investigations on the scattering of light, molecular optics and particularly in the researches leading to the discovery of the Raman Effect. While at Dacca, he started work on magnecrystallic action and made important contributions dealing with the significance of magnetic anisotropy to crystal structure. His more recent publications include papers dealing with pleochroism and fluorescence in crystals, properties of free electrons in solids, thermo-magnetic behaviour of crystals at low temperatures and other allied topics.

In 1936, he was invited to attend the International Conference on Photoluminescence held at Warsaw. In 1937, he toured in Europe and delivered lectures by invitation at the Cavendish Laboratory in Cambridge, at the Royal Institution in London and at other places. During that year, he was also awarded the Liege University medal. Last year, he again visited Europe as he was invited to participate in a conference on magnetism arranged at Strasbourg by the *International Institute for Intellectual Co-operation* which is one of the organisations of the League of Nations. On this occasion as well, he delivered lectures at various universities in England and in the Continent. He presided over the Physics Section of the twenty-seventh annual meeting of the *Indian Science Congress* held early this year at Madras. As the Mahendra Lal Sircar Professor of Physics at the *Indian Association for the Cultivation of Science*, Calcutta, Krishnan guides with conspicuous success the activities of a productive school of research.

S. BHAGAVANTAM.

LETTERS TO THE EDITOR

Equilibrium between H_2O and D_2O

WITH a sample containing 99·4 per cent. D_2O, we investigated the changes in the structure of the Raman bands of H_2O and D_2O, when the liquids were mixed. A comparison of the pure H_2O and D_2O bands with those for the mixture, revealed a profound influence of each liquid on the other. A study of the distribution of intensity in the bands corresponding to each compound, indicated clearly the following results.

While the Raman band for pure H_2O, with its maximum at 3443 extended from 2977–3817 with two inflections at 3229 and 3632, the same band for the mixture became narrower, the extent being reduced to 3080–3808. There is a slight shift in the central maximum from 3443 for the pure compound to 3461 for the mixture. More conspicuous is the change in the distribution of intensity on the lower frequency side of the band. While for pure water, the band had a definite convexity, in the mixture, this changed to a concavity, thus revealing a diminution in the intensity of this portion of the band.

The changes in the structure of the D_2O band were still more prominent. In the pure state, this liquid gives rise to a band extending from 2194 to 2844, with two clear maxima at 2538 and 2400. In the mixture, however, the second maximum entirely disappears, leaving the other with a slight shift to 2523. The width of the band also diminishes to 2244–2810.

To compare the relative intensities of the bands in the pure state with those in the mixture, the Raman spectra of the pure liquids and those of the mixture were taken on the same plate, the time of exposure for the mixture being double that for the pure liquids. If, on mixing, there were no changes in the structure of the liquids, the intensity distribution of the bands in the mixture should be the same as for the pure liquids. But actually, there was a decided change.

For pure water, the intensity of the maximum at 3443 showed a slight increase. But the maximum of the D_2O band at 2538 increased in intensity by nearly 50 per cent.

These changes are similar to those of change of state or of temperature, and are explicable on the basis of the change in the polymerisation of these liquids. The diminution of the intensity of the H_2O band on the lower frequency side in the mixture indicates the depolymerisation of the $(H_2O)_3$ molecules to which this portion of the band is supposed to

correspond. This change in the structure of the H_2O band lends support to the view that the $(H_2O)_3$ molecules are less stable than the other polymers as postulated by one of us.[1]

A similar explanation applies to the changes in the structure of the D_2O band. The disappearance, in the band for the mixture, of the maximum at 2400 supposed to correspond to $(D_2O)_3$ molecules, is due to the instability of this polymer as compared to $(D_2O)_2$ and D_2O.

In addition to the above changes, there is another possibility, *viz.*, that of the formation of HDO. The frequencies of this compound as calculated by Van Vleck and Cross[2] are 1400, 2720 and 3750 and the experimental value for the vapour reported by Rank, Larson and Bordner[3] is 2718. The latter found no trace of any lines corresponding to 3750 and 1400 for HDO. The above result seems to be confirmed by our work also. While there is a considerable increase in the intensity of the D_2O band from the pure state to the mixture, the corresponding H_2O band increases only slightly in intensity.

As required by the law of mass action, the proportion of HDO molecules formed in a 50 : 50 mixture of H_2O and D_2O studied by us should be 48·6 per cent. while H_2O and D_2O are each 25·7 per cent., if the equilibrium constant is assumed to be 3·28 as given by Urey and Rittenberg.[4] The abnormal increase in the intensity of the D_2O band must be due to the superposition of the HDO band over it (Wood[5] gives the frequency of this band for the liquid state as 2623 cm.$^{-1}$), while in the case of the H_2O band, the slight increase in intensity is due only to the splitting up of the higher polymers of water into the lower, which thus increase the number of the double molecules giving rise to the maximum at the centre of the H_2O band, there being no contribution to this increase by the O-H oscillation of the HDO molecules as no band due to this oscillation was detected by Rank, Larson and Bordner.

Thus while there are two factors, *viz.*, increase in double molecules of D_2O and superposition of the HDO band which increase the intensity of the band in the case of D_2O, counterbalancing the diminution in the number of the D_2O molecules on account of conversion into HDO molecules, there is only one factor which tends to increase the intensity of the water band, *viz.*, the increased number of $(H_2O)_2$ molecules, due to the depolymerisation of the $(H_2O)_3$ molecules, which are just more than counterbalancing their diminution due to conversion into HDO molecules.

I. RAMAKRISHNA RAO.
Y. PARAMASIVA RAO.

Andhra University,
Waltair,
March 14, 1940.

1 I. R. Rao, *Proc. Roy. Soc.*, 1934, **145 A**, 489.
2 Van Vleck and Cross, *J. Chem. Phys.*, 1933, **1**, 357.
3 Rank, Larson and Bordner, *ibid.*, 1934, **2**, 464.
4 Urey and Rittenberg, *ibid.*, 1933, **1**, 137.
5 R. W. Wood, *Phys. Rev.*, 1934, **45**, 392.

Structure of λ 2916 of OD and the Mass Ratio of the Hydrogen Isotopes

IN the course of a general investigation on the emission bands of heavy water, the authors have photographed discharges through vapour of pure heavy water and obtained the electronic band system $^2\Sigma^+ \rightarrow {}^2\pi_{\text{inv}}$ of the OD molecule in the region λ3600 — λ2400, perfectly free from any trace of the bands of the OH molecule. Measurement of the bands have led to the elucidation of the rotational structure of the (1, 0) and (2, 1) bands at λ2872 and λ2916 and to the evaluation of the associated constants of the OD molecule. The values determined for the band at λ2872 have been communicated to *Nature*. The constants for the band at λ2916 are (in cm.$^{-1}$),

$$B_2' = 8 \cdot 317 \qquad D_2' = - \cdot 597 \times 10^{-3}$$
$$B_1'' = 9 \cdot 544 \qquad D_1'' = - \cdot 413 \times 10^{-3}$$

The wave numbers of the lines $R_1(1)$ and $Q_1(1)$ are 34273·4 and 34238·1 cm.$^{-1}$ respectively.

Supplementing the data on these bands, with those published by Ishaq[1] it has been possible to determine the vibrational energy intervals

for the upper $^2\Sigma^+$ state. These are $\Delta\nu'_{\frac{1}{2}} = 2214 \cdot 6$; $\Delta\nu'_{1\frac{1}{2}} = 2110 \cdot 6$; $\Delta\nu'_{2\frac{1}{2}} = 2009 \cdot 2$. The value of ω'_e deduced from these, gives the mass ratio of the hydrogen isotopes

$$\rho = \frac{\omega_e'\,(\mathrm{OD})}{\omega_e'\,(\mathrm{OH})} = 0 \cdot 7282$$

which agrees well with the value $0 \cdot 7281$ calculated directly from the isotopic masses $H^1 = 1 \cdot 0081$ and $H^2 = 2 \cdot 0142$.

Full details will be published elsewhere.

K. R. RAO.
M. G. SASTRY.

Andhra University,
Waltair,
March 21, 1940.

[1] *Proc. Roy. Soc.*, 1937, **159A**, 110; *Proc. Nat. Inst. Sci. India*, 1937, **3**, 389.

Interaction of Atomic Energy Levels Part III

IN continuation of the work previously described in this *Journal*,[1] we have investigated a mixture of cadmium and zinc and compared the relative intensities of various lines in the spectra of the individual metals and in that of their mixture. The method employed to obtain the spectra was the same as before, *viz.*, a discharge from a 2,000 volt 3 KVA transformer sent through a tube containing the metals in side limbs and kept continuously evacuated by a Hyvac Pump. The following changes in relative intensity were observed: square brackets indicate that the change in intensity was small.

ZINC LINES

Strengthened	*Weakened*
3076 $(4^1S_0-4^3P_1)$	[6362 $(4^1P_1-4^1D_2)$]
[2558 (Zn II)]	4810 $(4^3P_2-5^3S_1)$
	4722 $(4^3P_1-5^3S_1)$
	4680 $(4^3P_0-5^3S_1)$
	4630 $(4^1P_1-5^1D_2)$
	[3072 $(4^3P_2-6^3S_1)$]
	[3035 $(4^3P_1-6^3S_1)$]
	[3018 $(4^3P_0-6^3S_1)$]
	[2800 $(4^3P_2-5^3D_3)$]
	[2770 $(4^3P_1-5^3D_2)$]
	[2756 $(4^3P_0-5^3D_1)$]
	[2712 $(4^3P_2-7^3S_1)$]
	[2684 $(4^3P_1-7^3S_1)$]
	[2670 $(4^3P_0-7^3S_1)$]
	[2609 $(4^3P_2-6^3D_3)$]
	[2583 $(4^3P_1-6^3D_2)$]
	[2570 $(4^3P_0-6^3D_1)$]
	[2516 $(4^3P_2-7^3D_3)$]
	[2492 $(4^3P_1-7^3D_2)$]
	2480 $(4^3P_0-7^3D_1)$
	2464 $(4^3P_2-8^3D_3)$
	[2139 $(4^1S_0-4^1P_1)$]

CADMIUM LINES

Strengthened	*Weakened*
6438 $(5^1P_1-5^1D_2)$	[5086 $(5^3P_2-6^3S_1)$]
6330 $(5^1P_1-5^3D_1)$	4800 $(5^3P_1-6^3S_1)$
6325 $(5^1P_1-5^3D_2)$	4678 $(5^3P_0-6^3S_1)$
[3252 $(5^3P_2-7^3S_1)$]	4663 $(5^1P_1-6^1D_2)$
[3133 $(5^3P_1-7^3S_1)$]	4413 $(5^3P_1-6^1S_0)$
[3081 $(5^3P_0-7^3S_1)$]	
[2868 $(5^3P_2-8^3S_1)$]	
2775 $(5^3P_1-8^3S_1)$	
2764 $(5^3P_2-7^3D_{3,2})$	
2734 $(5^3P_0-8^3S_1)$	
[2677 $(5^3P_1-7^3D_2)$]	
[2660 $(5^3P_2-8^3D_3)$]	
[2640 $(5^3P_0-7^3D_1)$]	
2288 $(5^1S_0-5^1P_1)$	
2265 (Cd II)	

Discussion.—Taking first the lines that are strengthened, the increase in intensity of 3076 of Zn (upper level has an energy $= 32501 \cdot 6$ cm.$^{-1}$) must be due to impacts of the second kind with metastable Cd atoms in the 5^3P_2 state (of energy $31827 \cdot 3$ cm.$^{-1}$). 6438, 6330 and 6325 of Cd have upper levels of energy $59219 \cdot 6$, $59486 \cdot 4$ and $59498 \cdot 1$ cm.$^{-1}$ respectively. The nearest energy levels in zinc are $5^3P_{0,1,2}$ of energy $61247 \cdot 4$, $61274 \cdot 1$ and $61330 \cdot 3$ cm.$^{-1}$ respectively, but lines having these as upper levels are outside the region of our observations so that confirmatory evidence for the interaction of these two sets of levels cannot be adduced. The strengthening of 2764, 2677 and 2640 (energy of upper states is $67997 \cdot 5$, $67992 \cdot 5$ and $67988 \cdot 9$ cm.$^{-1}$) and the weakening of 2800, 2770, 2756 of Zn (upper

correspond. This change in the structure of the H_2O band lends support to the view that the $(H_2O)_3$ molecules are less stable than the other polymers as postulated by one of us.[1]

A similar explanation applies to the changes in the structure of the D_2O band. The disappearance, in the band for the mixture, of the maximum at 2400 supposed to correspond to $(D_2O)_3$ molecules, is due to the instability of this polymer as compared to $(D_2O)_2$ and D_2O.

In addition to the above changes, there is another possibility, *viz.*, that of the formation of HDO. The frequencies of this compound as calculated by Van Vleck and Cross[2] are 1400, 2720 and 3750 and the experimental value for the vapour reported by Rank, Larson and Bordner[3] is 2718. The latter found no trace of any lines corresponding to 3750 and 1400 for HDO. The above result seems to be confirmed by our work also. While there is a considerable increase in the intensity of the D_2O band from the pure state to the mixture, the corresponding H_2O band increases only slightly in intensity.

As required by the law of mass action, the proportion of HDO molecules formed in a 50 : 50 mixture of H_2O and D_2O studied by us should be 48·6 per cent. while H_2O and D_2O are each 25·7 per cent., if the equilibrium constant is assumed to be 3·28 as given by Urey and Rittenberg.[4] The abnormal increase in the intensity of the D_2O band must be due to the superposition of the HDO band over it (Wood[5] gives the frequency of this band for the liquid state as 2623 cm.$^{-1}$), while in the case of the H_2O band, the slight increase in intensity is due only to the splitting up of the higher polymers of water into the lower, which thus increase the number of the double molecules giving rise to the maximum at the centre of the H_2O band, there being no contribution to this increase by the O-H oscillation of the HDO molecules as no band due to this oscillation was detected by Rank, Larson and Bordner.

Thus while there are two factors, *viz.*, increase in double molecules of D_2O and superposition of the HDO band which increase the intensity of the band in the case of D_2O, counterbalancing the diminution in the number of the D_2O molecules on account of conversion into HDO molecules, there is only one factor which tends to increase the intensity of the water band, *viz.*, the increased number of $(H_2O)_2$ molecules, due to the depolymerisation of the $(H_2O)_3$ molecules, which are just more than counterbalancing their diminution due to conversion into HDO molecules.

I. RAMAKRISHNA RAO.
Y. PARAMASIVA RAO.

Andhra University,
Waltair,
March 14, 1940.

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1 I. R. Rao, *Proc. Roy. Soc.*, 1934, **145 A**, 489.
2 Van Vleck and Cross, *J. Chem. Phys.*, 1933, **1**, 357.
3 Rank, Larson and Bordner, *ibid.*, 1934, **2**, 464.
4 Urey and Rittenberg, *ibid.*, 1933, **1**, 137.
5 R. W. Wood, *Phys. Rev.*, 1934, **45**, 392.

Structure of λ 2916 of OD and the Mass Ratio of the Hydrogen Isotopes

IN the course of a general investigation on the emission bands of heavy water, the authors have photographed discharges through vapour of pure heavy water and obtained the electronic band system $^2\Sigma^+ \rightarrow {}^2\pi_{\mathrm{inv}}$ of the OD molecule in the region $\lambda3600 - \lambda2400$, perfectly free from any trace of the bands of the OH molecule. Measurement of the bands have led to the elucidation of the rotational structure of the (1, 0) and (2, 1) bands at $\lambda2872$ and $\lambda2916$ and to the evaluation of the associated constants of the OD molecule. The values determined for the band at $\lambda2872$ have been communicated to *Nature*. The constants for the band at $\lambda2916$ are (in cm.$^{-1}$),

$$B_2' = 8\cdot317 \qquad D_2' = -\cdot597 \times 10^{-3}$$
$$B_1'' = 9\cdot544 \qquad D_1'' = -\cdot413 \times 10^{-3}$$

The wave numbers of the lines $R_1(1)$ and $Q_1(1)$ are 34273·4 and 34238·1 cm.$^{-1}$ respectively.

Supplementing the data on these bands, with those published by Ishaq[1] it has been possible to determine the vibrational energy intervals

for the upper $^2\Sigma^+$ state. These are $\Delta\nu'_{\frac{1}{2}} = 2214{\cdot}6$; $\Delta\nu'_{1\frac{1}{2}} = 2110{\cdot}6$; $\Delta\nu'_{2\frac{1}{2}} = 2009{\cdot}2$. The value of ω'_e deduced from these, gives the mass ratio of the hydrogen isotopes

$$\rho = \frac{\omega_e'\,(\mathrm{OD})}{\omega_e'\,(\mathrm{OH})} = 0{\cdot}7282$$

which agrees well with the value 0·7281 calculated directly from the isotopic masses $H^1 = 1{\cdot}0081$ and $H^2 = 2{\cdot}0142$.

Full details will be published elsewhere.

K. R. Rao.
M. G. Sastry.

Andhra University,
Waltair,
March 21, 1940.

[1] *Proc. Roy. Soc.*, 1937, **159A**, 110; *Proc. Nat. Inst. Sci. India*, 1937, **3**, 389.

Interaction of Atomic Energy Levels Part III

In continuation of the work previously described in this *Journal*,[1] we have investigated a mixture of cadmium and zinc and compared the relative intensities of various lines in the spectra of the individual metals and in that of their mixture. The method employed to obtain the spectra was the same as before, *viz.*, a discharge from a 2,000 volt 3 KVA transformer sent through a tube containing the metals in side limbs and kept continuously evacuated by a Hyvac Pump. The following changes in relative intensity were observed: square brackets indicate that the change in intensity was small.

Zinc Lines

Strengthened	*Weakened*
3076 ($4^1S_0-4^3P_1$)	[6362 ($4^1P_1-4^1D_2$)]
[2558 (Zn II)]	4810 ($4^3P_2-5^3S_1$)
	4722 ($4^3P_1-5^3S_1$)
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	4630 ($4^1P_1-5^1D_2$)
	[3072 ($4^3P_2-6^3S_1$)]
	[3035 ($4^3P_1-6^3S_1$)]
	[3018 ($4^3P_0-6^3S_1$)]
	[2800 ($4^3P_2-5^3D_3$)]
	[2770 ($4^3P_1-5^3D_2$)]
	[2756 ($4^3P_0-5^3D_1$)]
	[2712 ($4^3P_2-7^3S_1$)]
	[2684 ($4^3P_1-7^3S_1$)]
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	[2609 ($4^3P_2-6^3D_3$)]
	[2583 ($4^3P_1-6^3D_2$)]
	[2570 ($4^3P_0-6^3D_1$)]
	[2516 ($4^3P_2-7^3D_3$)]
	[2492 ($4^3P_1-7^3D_2$)]
	2480 ($4^3P_0-7^3D_1$)
	2464 ($4^3P_2-8^3D_3$)
	[2139 ($4^1S_0-4^1P_1$)]

Cadmium Lines

Strengthened	*Weakened*
6438 ($5^1P_1-5^1D_2$)	[5086 ($5^3P_2-6^3S_1$)]
6330 ($5^1P_1-5^3D_1$)	4800 ($5^3P_1-6^3S_1$)
6325 ($5^1P_1-5^3D_2$)	4678 ($5^3P_0-6^3S_1$)
[3252 ($5^3P_2-7^3S_1$)]	4663 ($5^1P_1-6^1D_2$)
[3133 ($5^3P_1-7^3S_1$)]	4413 ($5^3P_1-6^1S_0$)
[3081 ($5^3P_0-7^3S_1$)]	
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2775 ($5^3P_1-8^3S_1$)	
2764 ($5^3P_2-7^3D_{2,2}$)	
2734 ($5^3P_0-8^3S_1$)	
[2677 ($5^3P_1-7^3D_2$)]	
[2660 ($5^3P_2-8^3D_3$)]	
[2640 ($5^3P_0-7^3D_1$)]	
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2265 (Cd II)	

Discussion.—Taking first the lines that are strengthened, the increase in intensity of 3076 of Zn (upper level has an energy = 32501·6 cm.$^{-1}$) must be due to impacts of the second kind with metastable Cd atoms in the 5^3P_2 state (of energy 31827·3 cm^{-1}). 6438, 6330 and 6325 of Cd have upper levels of energy 59219·6, 59486·4 and 59498·1 cm.$^{-1}$ respectively. The nearest energy levels in zinc are $5^3P_{0,1,2}$ of energy 61247·4, 61274·1 and 61330·3 cm.$^{-1}$ respectively, but lines having these as upper levels are outside the region of our observations so that confirmatory evidence for the interaction of these two sets of levels cannot be adduced. The strengthening of 2764, 2677 and 2640 (energy of upper states is 67997·5, 67992·5 and 67988·9 cm.$^{-1}$) and the weakening of 2800, 2770, 2756 of Zn (upper

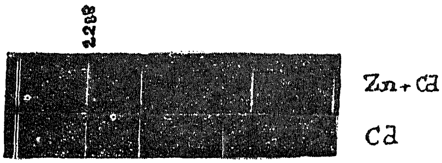


FIG. 1

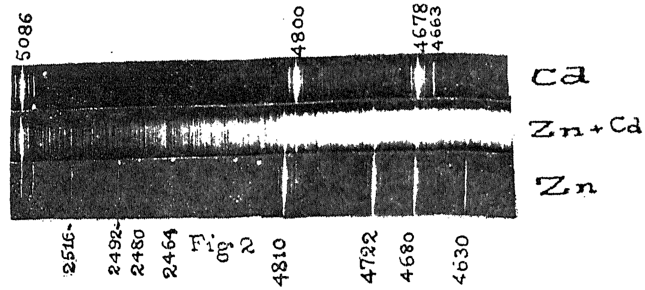


FIG. 2

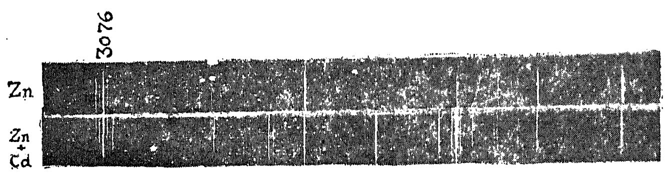


FIG. 3

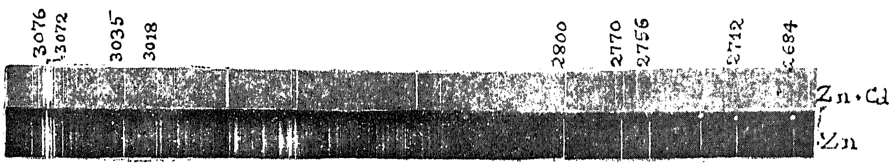


FIG. 4

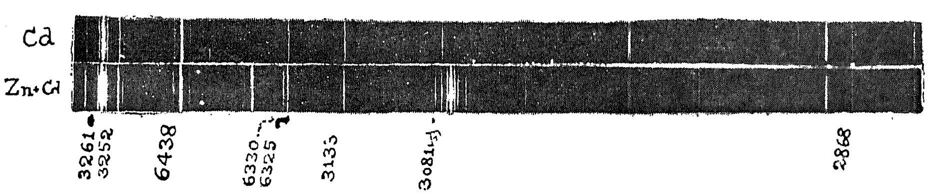
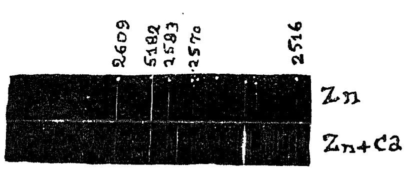


FIG. 5



F G. 6

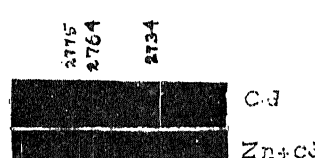


FIG. 7

levels are 68582·9, 68580·9 and 68579·8 cm.$^{-1}$) and of 2712, 2684 and 2670 (upper level = 69746·3 cm.$^{-1}$) points to interaction between these groups of levels. 4630 of Zn (upper level 68337·9 cm.$^{-1}$) has become weaker. Its excitation energy seems to have been taken up by 2734, 2775 and 2868 (upper level = 66681·5 cm.$^{-1}$). which have become strengthened. This latter level may also have been enriched at the expense of 3072, 3035 and 3018 (upper level = 65432·4 cm.$^{-1}$), which are slightly weakened. The slight weakening of Zn 6362 (upper level = 62458·6 cm.$^{-1}$) may be correlated with the slight brightening of 3252, 3133 and 3081 (upper level = 62563·2). The brightening of Cd 2288 (upper level = 43692·2 cm.$^{-1}$) must be brought about by 4^1P_1 of zinc of energy 46745·1 cm.$^{-1}$ and the weakening of 2139 of Zn confirms this. 2139, however, does not affect our film sufficiently to show up clearly and hence it cannot be seen in the reproduction. The strengthening of Cd 2660 (upper level = 69404·3 cm.$^{-1}$) is possibly connected with the weakening of the zinc lines 2609, 2583 and 2570 (upper level = 71213·5 cm.$^{-1}$), 2516, 2492 and 2480 (upper level = 72628·1 cm.$^{-1}$) and 2464 (upper level = 73471·3 cm.$^{-1}$) of Zn, all of which are weakened, have excitation energies very near the ionization energy of cadmium which is 72538·8 cm.$^{-1}$. The slight increase in brightness of the spark line 2265 of Cd may be due to the ionization thus produced. The simultaneous weakening of Zn 4810, 4722, 4680 (upper level = 53672·4 cm.$^{-1}$) and of Cd 5086, 4800, 4678 (upper level = 51484·1 cm.$^{-1}$) is difficult to explain except by assuming that the energy of the first group is given to ionised Cd and that of the second to ionised Zn. Since the spark lines of Zn and Cd are very weak, support for this view is difficult to obtain from their behaviour. The weakening of 4663 (upper level = 65133·9) of Cd will have to be explained in a similar way by assuming that its energy is used to strengthen some spark line, probably 2265 of Cd, but this explanation is only tentative.

In conclusion we have great pleasure in expressing our thanks to Prof. A. Venkat Rao Telang for the many facilities given to us.

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K. SESHADRI.
N. A. NARAYANA RAO.

Central College,
Bangalore,
April 12, 1940.

1 *Curr. Sci.*, 1939, **8**, 508; 1940, **9**, 14.

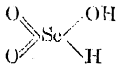
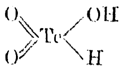
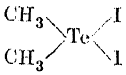
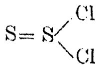
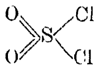
Molecular Structure of Some of the Selenium and Tellurium Compounds

PAULING,[1] Van Vleck,[2] Slater[3] and Angus[4] have shown that the diamagnetic susceptibility of an ion is given by $\chi_A = -\dfrac{e^2z}{6mc^2}\ \Sigma\overline{r^2}$, where $\Sigma\overline{r^2}$ depends upon the valency state of the ion. The validity of this expression has been verified by Farquharson,[5] Gray and Cruickshank,[6] Clow[7] and Bhatnagar and co-workers.[8]

Varadachari and Subramaniam[9] and Nevgi[10] have determined the susceptibilities of a number of sulphur compounds and using Kido's values for the ionic susceptibility of sulphur in different valency states, have assigned suitable valencies to sulphur in these compounds. We have measured the magnetic susceptibilities of about a dozen compounds of selenium and tellurium by the modified form of Gouy's Balance and have calculated the theoretical values of selenium and tellurium in different valency states using Slater's and Angus's methods for the calculation of $\Sigma\overline{r^2}$. The calculated and observed values for some of these compounds are shown in Table I.

Incidentally we have calculated the values of $\Sigma\overline{r^2}$ according to Slater's and Angus's methods and hence the ionic susceptibilities, for sulphur in different valency states and have used them to calculate the susceptibilities of the sulphur compounds studied by Varadachari and Subramaniam and Nevgi. Table I shows that the values thus calculated for S_2Cl_2 and SO_2Cl_2 agree closely with those experimentally found by Varadachari and Subramaniam and Nevgi, respectively.

TABLE I

Compound	Correct constitution	$-\chi_a \times 10^6$ & $\chi_m \times 10^6$ observed by the authors	$\chi_a \times 10^6$ & $\chi_m \times 10^6$ calculated by Slater's method	$\chi_a \times 10^6$ & $\chi_m \times 10^6$ calculated by Angus's method
Se_2Br_2 ..	Br–Se–Se–Br	(χ_a) 0·3544	0·3479	0·3400
		(χ_m) 112·6	110·72	108·18
H_2SeO_3 ..		(χ_a) 0·3515	0·3470	0·3465
		(χ_m) 45·41	44·84	44·77
H_2TeO_3 ..		(χ_a) 0·1966	0·1978	0·1972
		(χ_m) 34·89	35·12	35·00
$(CH_3)_2TeI_2$ ..		(χ_a) 0·3535	0·3547	0·3512
		(χ_m) 145·40	145·85	145·71
S_2Cl_2 ..		(χ_a) 0·461 } [9]	0·4613	0·4523
		(χ_m) 62·2	62·272	61·05
		(χ_a) 0·405 } [10]		
		(χ_m) 54·7		
SO_2Cl_2 ..		(χ_a) 0·365 } [9]	0·3891	0·3884
		(χ_m) 49·3	52·517	52·422
		(χ_a) 0·397 } [10]		
		(χ_m) 53·6		
		(χ_a) 0·402 } (Kido)		
		(χ_m) 54·6		

A full account of the work is being sent for publication elsewhere. Authors are thankful to Dr. S. S. Bhatnagar for suggestion and criticisms.

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Chemical Laboratories,
Royal Institute of Science,
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April 2, 1940.

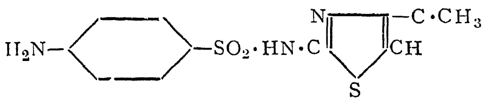
[1] Pauling, *P. R. S.*, 1927, **114** A, 181.
[2] Van Vleck, *Phys. Rev.*, 1928, **31**, 587.
[3] Slater, *ibid.*, 1930, **36**, 57.
[4] Angus, *P. R. S.*, 1932, **136** A, 569.
[5] Farquharson, *Phil. Mag.*, 1932, **14**, 1003.
[6] Gray and Cruickshank, *Trans. Farad. Soc.*, 1935, **32**, 1491.
[7] Clow, *ibid.*, 1937, **33**, 381.
[8] Bhatnagar, *Curr. Sci.*, 1935, **4**, 153, 234; *J. Ind. Chem. Soc.*, 1935, **12**, 799; *J. C. S.*, 1936, **13**, 278; *ibid.*, 1938, 1428; *Proc. Ind. Acad. Sci.*, 1939, **10**, 150.
[9] Varadachari and Subramaniam, *Proc. Ind. Acad. Sci.*, 1936, **3A**, 428.
[10] Nevgi, *J. Univ. Bombay*, 1938, **7**, 82.

Heterocyclic and Other Derivatives of Sulphanilamide

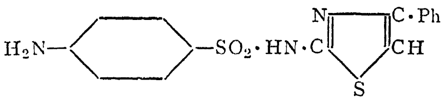
In continuation of our note,[1] a few other heterocyclic derivatives of sulphanilamide have been prepared. 2-Amino-4-methyl thiazole and 2-amino-4-phenyl thiazole have been condensed with para-acetamino benzene sulphochloride in acetone and pyridine and the products after hydrolysis with sodium hydroxide or hydrochloric acid, yielded respectively 2-N′-sulphanilamido-methyl thiazole (I) and 2-N′-sulphanilamido-phenyl thiazole (II).

Also 2-amino-anthraquinone has been condensed with para-acetamino benzene sulphochloride in a similar way and hydrolysis yielded 2-N′-sulphanilamido anthraquinone (III).

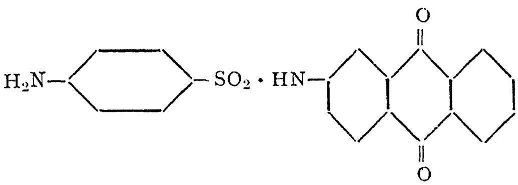
Amino-thiodiazines are also being condensed with para-acetamino benzene sulphochloride. One compound 2-N′-sulphanilamido 5-hydroxy-1 :3 :4-thiodiazine (IV) has been obtained by condensing 2-amino-5-hydroxy-1 :3 :4-thiodiazine[2] with para-acetamino benzene sulphochloride and subsequent hydrolysis.



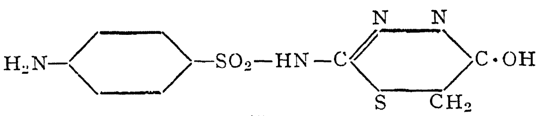
(I)



(II)



(III)



(IV)

Attempts are also being made to condense substituted thiodiazines[3,4] with para-acetamino benzene sulpho-chloride.

Detailed experiments and reports of their therapeutic value against bacterial infections will be published elsewhere.

B. K. Nandi.
K. Ganapathi.

Haffkine Institute,
Parel, Bombay,
March 20, 1940.

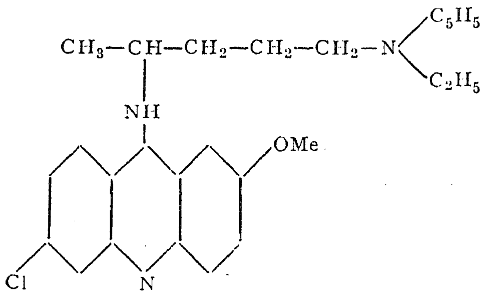
1 Ganapathi and Nandi, *Curr. Sci.*, 1940, **9**, 67.
2 Bose and Nandi, *Jour. Ind. Chem. Soc.*, 1930, **7**, 961.
3 ——, *ibid.*, 1930, **7**, 733.
4 ——, *ibid.*, 1931, **8**, 311.

Synthesis of Anti-Malarial Drugs in Acridine Series

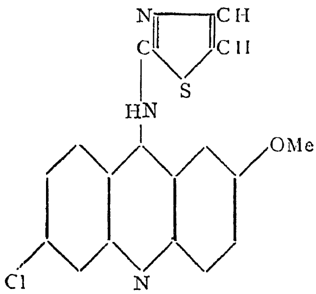
Since the synthesis of the remarkable anti-malarial drug atebrin[1] (I) various side chains have been attached to the acridine nucleus.[2] In all cases, however, the anti-malarial activity has been found to be decidedly inferior to atebrin. So far no heterocyclic or carbocyclic derivatives of 2-methoxy-6 :9-dichloro acridine[3] seem to have been reported. Some heterocyclic and carbocyclic derivatives of 2-methoxy-6 :9-dichloro acridine have now been prepared and their anti-malarial property is being studied in monkey malaria in this laboratory.

2-Amino thiazole has been condensed with 2-methoxy-6 :9-dichloro acridine in phenol medium giving 2-methoxy-6-chloro-9-N-2′-thiazole-amino acridine (II) in good yield. Similarly 2-amino-4-methyl thiazole and 2-amino-4-phenyl thiazole yielded respectively 2-methoxy-6-chloro-9-N-2′-(4′-methyl thiazole)-amino acridine (III) and 2-methoxy-6-chloro-9-N-2′(4′-phenyl thiazole)-amino acridine (IV). Also 2-amino-pyridine and 2-amino anthraquinone gave respectively 2-methoxy-6-chloro-9-N-2′-pyridyl-amino acridine (V) and 2-methoxy-6-chloro-9-N-2′- anthraquinone - amino acridine (VI). In a similar way, 6-methoxy-8-amino quinoline and 2-amino-5-hydroxy-1 :3 :4-thiodiazine[4] were condensed in phenol medium respectively giving rise to 2-methoxy-6-chloro-9-N-8′(6′- methoxy - quinoline) - amino

acridine (VII) and 2-methoxy-6-chloro-9-N-2′-(5-hydroxy-1 : 3 : 4-thiodiazine)-amino acridine (VIII).



(I)



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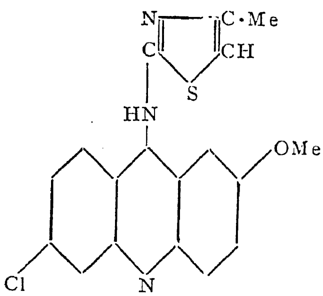

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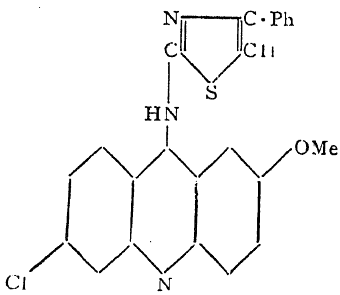

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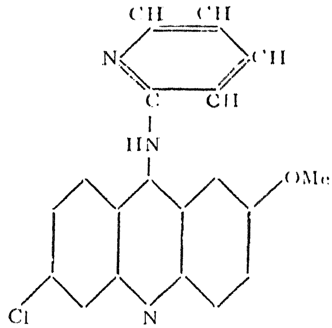

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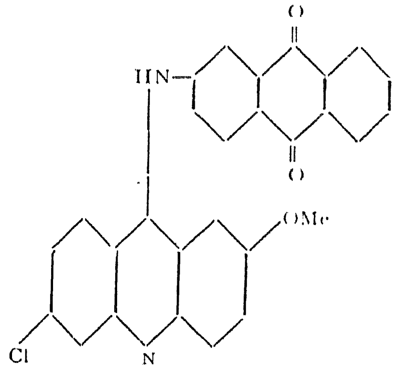

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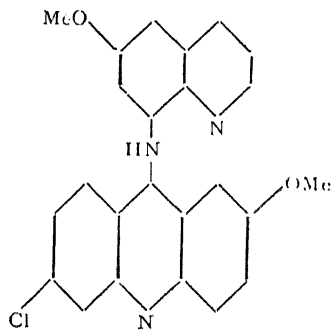

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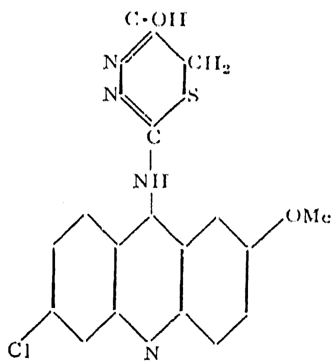

(VIII)

The condensation of sulphanilamide with 2-methoxy-6 : 9-dichloro acridine has already been reported.[5] Acridine derivatives of other amino-thiazoles and amino-thiodiazines are being prepared.

The detailed experiments and the results of their action against malaria and bacterial infections will be reported elsewhere.

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March 26, 1940.

[1] Mietsch and Mauss, *Klin, wchschr.*, 1933, No. 33, 12760.
[2] Magidson and Grigorowsky, *Ber.*, 1936, **69**, 396.
[3] Magidson *et al*, *Chem. Pharmaz. Ind.* (U.S.S.R.) 1935, No. 1.
[4] Bose and Nandi, *Jour. Ind. Chem. Soc.*, 1930, **7**, 961.
[5] Ganapathi and Nandi, *Curr. Sci.*, 1940, **9**, 67.

Pongamol, A New Crystalline Compound from Pongamia Oil

CRUDE karanjin extracted from the pongamia oil with alcohol[1] gave certain prominent colour reactions which were not produced by the purified compound. With concentrated sulphuric acid it gave a yellow solution which turned emerald green in the course of five minutes and when a drop of ferric chloride was added to an alcoholic solution an intense red colour was produced. This was obviously due to the existence of a second chemical entity to some extent in crude karanjin. The occurrence of this compound in pongamia seed oil and cake was investigated by means of the strong ferric chloride colour. Samples of oil and cake were extracted with alcohol and the alcoholic extracts tested with ferric chloride. Oil obtained by expression or by solvent extraction, fresh as well as old, gave positive tests. The seed cake left after pressing gave positive reaction, but not the one obtained by solvent extraction. The capacity to give the colour test is therefore closely associated with the presence of the oil, whose complete removal is the cause of the negative test with solvent-extracted cake.

The chemical compound responsible for the above bright colour reactions has now been isolated in a crystalline condition and is named "pongamol" indicating its origin and phenolic nature. It crystallises from alcohol in the form of big rhombic prisms and melts at 128–29°. It contains no nitrogen, sulphur and halogen and has the formula $C_{18}H_{14}O_4$. It possesses a methoxyl group, produces a red anthocyanin by reduction with magnesium and hydrochloric acid, gives a derivative with *p*-nitrobenzoyl chloride and yields benzoic acid on oxidation or hydrolytic fission. It therefore seems to belong to the important naturally occurring group of hydroxyflavones.

Details regarding the preparation, properties and constitution of pongamol will soon be published.

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T. R. SESHADRI.

Department of Chemistry,
Andhra University,
Waltair,
March 23, 1940.

[1] Subba Rao, Veerabhadra Rao and Seshadri, *Proc. Ind. Acad. Sci.*, 1939, **10A**, 65.

A New Disease of Wheat in India

ON March 7th, 1939, the author visited the Botanical Sub-station of the *Imperial Agricultural Research Institute* at Pusa. It was found that several varieties of wheat were suffering from foot-rot, the symptoms being suggestive of *Fusarium*. One variety, Pusa 12, had different symptoms. The plants were bleached and prematurely ripened and the ears contained only shrivelled grains. The sub-coronal internodes were found to be shiny black, and the roots were black and rotten. The symptoms were suggestive of "take-all".

Isolations were made from these plants a month later. Ten pieces of diseased tissue yielded in all seven cultures of *Fusarium* and one culture which in its mycelial characters resembled *Ophiobolus graminis* Sacc. It had the two kinds of hyphæ typical of the fungus

the fine hyaline septate hyphæ and the composite strands consisting of groups of thick "Macrohyphæ" dark in colour and strongly septate. The culture has so far produced no perithecia and no spores of any kind.

Owing to the hot weather prevalent at the time it was not convenient to make a test of the pathogenicity of the fungus.

In October 1939 twelve 100 c.c. Erlenmeyer flasks, each containing 45 grammes of soil, 5 grammes of maize-meal and 15 c.c. of water were sterilized and inoculated with the fungus. The contents of each flask were used on December 19th to infest sterilized soil in a six-inch flower pot. In each flower pot twenty-five seeds of Pusa 12 wheat were sown. On January 6th, 1940, the inoculated plants showed signs of withering and pallor of the youngest leaves and two days later they were turning distinctly yellow. The plants were much smaller than the control series in which sterilized maize-meal-soil mixture without the fungus had been added.

On removing the infected seedlings from the soil it was found that the bases of the stems were flecked with black and in severe cases were entirely of a black colour and shiny in appearance. The roots were rotten and black in colour, and carried on their surfaces the macro-hyphæ typical of *Ophiobolus graminis* (see photo-micrograph).

Macrohyphæ on the root of an inoculated wheat seedling. (× 123·75)

Whether or not the fungus is *Ophiobolus graminis* Sacc. can only be determined if perithecia are produced. It is certainly, however, a disease hitherto unrecorded in India.

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Imperial Agricultural Research Institute,
New Delhi,
March 27, 1940.

A Note on the Development of the Embryo-sac in *Vogelia indica* (Lamk.)

THE embryology of the Plumbaginaceæ has attracted considerable interest in recent years. Dahlgren[1] published a monograph on the Primulaceæ and Plumbaginaceæ, describing some striking peculiarities in the embryo-sac of *Plumbagella* and other genera of the Plumbaginaceæ. Haupt[2] gave a different account of the development of the embryo-sac in *Plumbago capensis* which was later confirmed by Dahlgren[3] himself. More recently Fagerlind[4] and Boyes[5] have re-investigated *Plumbagella* and in this also the development has been found to be very different from that reported by Dahlgren.

The present work on *Vogelia indica* was started in 1936 at the suggestion of Dr. P. Maheshwari. The plant grows on low-lying rocky hills at Ajmer and Mt. Abu, in Rajputana. The flowers appear in the winter season. The material was fixed in formalin-acetic-alcohol and Nawaschin's fluid and cut at 7–10 microns.

The pistil is closely surrounded by the flattened bases of the staminal filaments and contains a single ovule. When ripe, a long feathery style surmounts the small ovary.

The hypodermal archesporial cell in the nucellus divides into the primary parietal cell and megaspore-mother cell (Fig. 1). By further divisions of the former, two or three layers of wall are formed (Fig. 2). No tetrad of megaspores is produced and the mother cell grows directly into the embryo-sac. The single nucleus divides into two, nuclei and small vacuoles begin to appear even at this stage (Fig. 3). The next division gives rise to four megaspore nuclei which are placed cross-wise as shown in

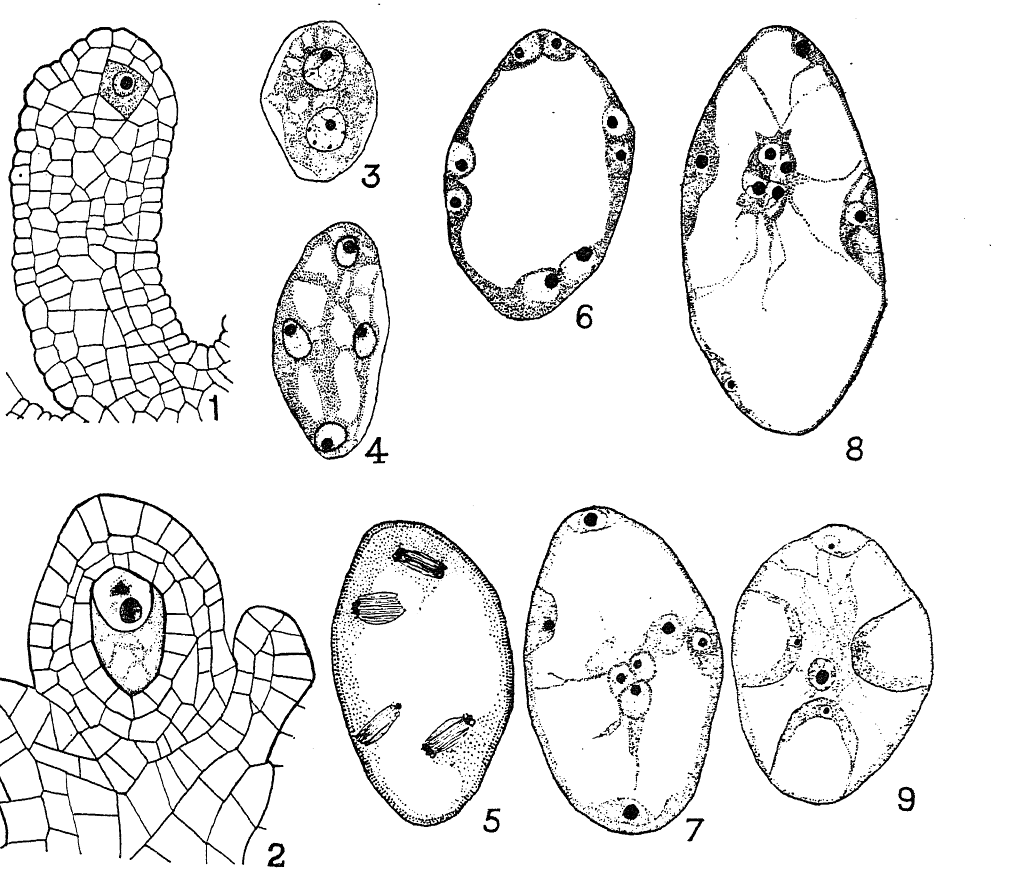


FIG. 1.—L. S. of young ovule, showing primary parietal cell divided anticlinally, and megaspore-mother cell. × 300. FIG. 2.—L. S. of ovule, showing two wall layers and megaspore-mother cell in prophase of reduction division × 400. FIG. 3.—Two-nucleate embryo-sac. × 400. FIG. 4.—Four-nucleate embryo-sac. × 400. FIG. 5.—Four mitoses in embryo-sac, leading to 8-nucleate condition. × 400. FIG. 6.—Eight-nucleate embryo-sac. × 400. FIG. 7.—Embryo-sac showing 4 nuclei meeting to form secondary nucleus. × 300. FIG. 8.—Embryo-sac showing 4 peripheral cells and four polar nuclei fusing in the centre. × 300. FIG. 9.—Mature embryo-sac showing 4 egg-like peripheral cells and secondary nucleus. ×200.

Fig. 4, the vacuolation becoming more prominent now. There is only one further division (Fig. 5), leading to the formation of 8 nuclei which lie in 4 pairs in the peripheral layer of cytoplasm (Fig. 6). The centre, at this stage, is occupied by a vacuole. As shown in Fig. 7, one nucleus from each pair now moves towards the centre and all the four meet to form a large secondary nucleus (Fig. 8). The remaining nucleus of each pair retains its parietal position, and the one towards the micropylar end organises into an egg cell. The other three showed a varied behaviour, which is still under investigation; generally they degenerate, but sometimes they also enlarge like the egg cell and actually become egg-like as evidenced by their structure and vacuolation (Fig. 9).

Such a development of the embryo-sac has so far been recorded only in *Plumbago capensis* (Haupt, 1934) and *Plumbago zeylanica* (Dahlgren, 1937). Further work is in progress and the results will be published very soon in a fuller form.

My slides were kindly examined by Dr. P. Maheshwari of Dacca, who has confirmed these interpretations. The writer is much indebted to

him for suggestions and criticisms in connection with this work.

KANHAIYA LAL MATHUR.

Government College,
Ajmer,
February 15, 1940.

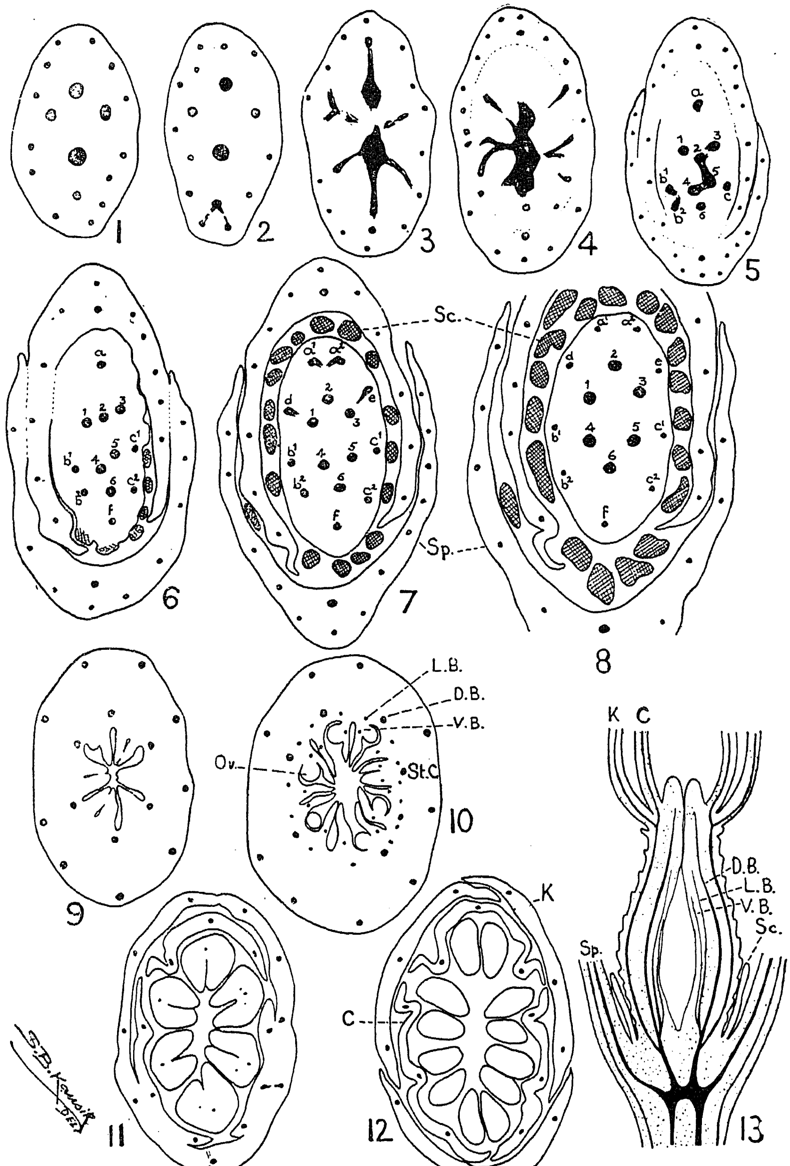
[1] Dahlgren, K. V. O., *K. Svenska Vetensk. Akad. Handl.*, 1916, **56**, (4), 80.
[2] Haupt, *Bot. Gaz.*, 1934, **95**, 649.
[3] Dahlgren, K. V. O., *Botaniska Not.*, 1937, 487.
[4] Fagerlind, *Arkiv. Bot.*, 1938, **29** B, 8.
[5] Boyes, J. W., *Amer. Jour. Bot.*, 1939, **26**, 539.

Vascular Anatomy of the Pistillate Flower of *Enalus acoroides* (L. fil.), Steud.

RECENTLY during the course of a detailed study of the embryology of *Enalus acoroides* (L. fil.), Steud., the writer[1] noticed certain interesting features in the vascular structure of the pistillate flowers and a brief account of these is given now in the present paper. A transverse section of the scape of the flower shows the presence of two large vascular bundles in the centre and a large number of smaller bundles along the periphery. The two central bundles are slightly unequal in size and to this feature has been attributed the coiling of the scape by which the pistillate flower goes under water subsequent to pollination (*cf.* Svedelius[2]). At the base of the flower these two central bundles begin to move towards each other and finally fuse together giving off at the same time a number of branches which move outwards immediately. These branches are next seen arranging themselves in a ring within the original peripheral bundles of the scape. Thus two sets of outer bundles are now formed (Fig. 5) and these two sets enter the two imbricating spathes of the flower (Figs. 5–7). Soon after the departure of these bundles to the spathes the floral vascular tissue shrinks more or less to the centre and gives rise typically to six large bundles (Fig. 5, marked 1–6), which rapidly undergo a process of readjustment and become regularly arranged (Figs. 6–8). At the same time the six bundles also divide once tangentially and give rise to an outer set of as many, but slightly smaller, bundles (Figs. 5–7). Simultaneously with this three alternating bundles of this outer set divide once radially to form three clearly recognizable pairs (Figs. 5–8, marked a, a^1, a^2; b, b^1, b^2; and c, c^1, c^2). The other three bundles of this set do not divide, but merely move towards the periphery along with the paired bundles. Thus there are now seen at the base of the ovary altogether nine bundles in the periphery and six large bundles forming a circle in the centre (Fig. 8). Both these sets of bundles enter the gynoecium, the outer set of nine pursuing their course further in the wall of the gynoecium, while the inner six form the vascular supplies of the six carpels. Each bundle of the inner set divides at a slightly higher level to form five main bundles, of which the median becomes a large dorsal bundle of the carpel and the others form the two lateral bundles and the two ventral bundles (Figs. 10 and 13).

In the outer set the nine bundles traversing the wall of the gynoecium (Figs. 8, *a*–*f*) represent the combined sepal-petal traces and the separation into the vascular supplies for the two sets of floral leaves takes place only above the ovary where each of the combined traces divides once tangentially. Thus two sets of nine bundles each are formed, of which the outer set constitutes the sepal bundles, each sepal receiving three bundles and the inner set forms the vascular connections to the petals, each petal also receiving three bundles (Figs. 11 and 12).

In the above description attention is confined only to what may be regarded as a typical vascular structure at the base of the gynoecium with a peripheral set of nine bundles (combined sepal-petal traces) and an inner set of six bundles (for the six carpels). But sometimes there is seen an extra bundle in the peripheral set and this is placed close to and slightly towards the inside of one of the main bundles from which it is evidently formed as a branch. This represents an early tangential splitting of one of the main bundles of the peripheral set



FIGS. 1 and 2. Transverse section of the scape of the pistillate flower. FIGS. 3 and 4. The fusion of the two large central vascular bundles and the formation of branches from these. FIGS. 5–7. The departure of the vascular bundles to the spathes and the formation of the six large central bundles (marked *1–6*) and the outer set of nine bundles (marked *a–f*) which are the combined vascular traces to the sepals and petals; the six large central bundles are arranging themselves regularly as an inner ring and form the vascular supplies to the six carpels. FIGS. 8–10. Sections at higher levels showing the arrangement of the bundles; in Fig. 10 the formation of the dorsal, lateral and ventral bundles is seen and an extra sterile carpel is also marked (*St.C.*). FIGS. 11 and 12. Section higher up showing the separation of the two sets of floral leaves and the tangential splitting of the combined sepal-petal traces; the paired stigmatic lobes are also shown. FIG. 13. Diagrammatic longitudinal section of the pistillate flower to show the vascular connections to the different floral organs. *Sp.*–spathe; *L.B.*–lateral bundle; *D.B.*–dorsal bundle; *V.B.*—ventral bundle; *Ov.*–ovule; *Sc.*–mucilage-secreting scales; *K.*–calyx; *C.*–corolla.

even as low as at the base of the gynoecium, while the others divide only very much higher up where the actual separation of the two sets of floral leaves takes place. Similarly extra bundles are also met with in the inner set of bundles forming the vascular connections to the carpels. In such cases the gynoecium shows seven or eight carpels instead of the usual six and the extra bundles are related then to the additional carpels. These extra carpels appear to be invariably sterile and in Fig. 10 such a sterile extra carpel is shown (*St. C.*).

Above the ovary each carpel forms two stigmatic lobes which appear paired in a transverse section and the number of such pairs corresponds to the total number of carpels making up the gynoecium (Figs. 11 and 12). The pairs of stigmatic lobes are arranged in a circle forming a large cavity in the centre as a pollen collecting chamber. The carpellary vascular bundles reach only the lower portions of the stigmatic lobes, but disappear higher up.

Svedelius[2] regarded that the gynoecium in *Enalus acoroides* is "composed of six carpels which form a unilocular ovary divided into six cavities" and that the "parietal placentæ project to the middle of the ovary and are, as in so many of the Hydrocharitaceæ, split quite into two lamellæ". Following this, Cunningham[3] also described "a syncarpous unilocular inferior ovary with from 6 to 8 carpels". But Troll[4] has recently shown that the gynoecium in this, as well as in the other Hydrocharitaceæ, is really apocarpous and that it appears to be syncarpous only apparently. He designates such a gynoecium a pseudo-coenocarpous one. Further, he states that in the attainment of this condition the floral receptacle, which is said to become cup-like, is fused with the dorsal portions of the otherwise free carpels. On the other hand, the present anatomical study suggests that the outer wall of the gynoecium is made up of the fused basal portions of the two sets of floral leaves, for, the nine peripheral bundles which are recognizable at the base of the gynoecium are really combined sepal-petal traces, and the receptacular vascular tissue ends below the level at which these bundles and the main vascular supplies of the carpels are formed. The outer floral whorls are adnate to the carpels over a considerable distance and are free only above the gynoecium, which thereby has become not only pseudo-coenocarpous, but also inferior. Recently, Joshi and Pantulu[5] have shown from a study of *Polianthes tuberosa* Linn. that the inferior ovary in the Amaryllidaceæ is the result of fusion of the basal portions of the outer floral whorls with the carpels. Eames[6] states: "The inferior ovary represents adnation in its extreme form. Comparative studies, made with the understanding that fusion of organs ultimately brings about fusion of the skeletal tissues also, demonstrate that the inferior ovary in nearly all—perhaps in all—families has resulted from the adnation of the outer floral whorls to the carpels." Finally, it may be stated here that the central axis of the flower which Troll[4] represents in his figures as a small projection at the base of the ovary in *Enalus* could not be made out in any of the preparations, though a careful examination was made through a complete series of transverse sections.

In conclusion, the writer wishes to record his sincere thanks to Prof. M. A. Sampathkumaran, Head of the Department of Botany, for his very critical reading of this paper.

S. B. Kausik.

Department of Botany,
University of Mysore, Central College,
Bangalore,
March 4, 1940.

1 Kausik, S. B., *Proc. Ind. Acad. Sci.*, 1940, **11**, 83.

2 Svedelius, N., *Ann. Roy. Bot. Gard. Peradeniya*, 1904, 2, 267.

3 Cunningham, H. M., *Trans. Linn. Soc. Lond. Bot.*, 1912, **7**, 355.

4 Troll, W., *Planta*, 1931, **14**, 1.

5 Joshi, A. C., and Pantulu, J. V., *Curr. Sci.*, 1939, 8, 212.

6 Eames, A. J., *Amer. J. Bot.*, 1931, **18**, 147.

Some Chemical and Physical Properties of Water Caltrop Starch

In a previous paper[1] a method was described for the production of starch from water caltrop. Some uses for this starch were proposed and it was stated that with a view to find its suitability as a sizing and finishing material, experimental work on some of the chemical properties, and penetrating and coating power on cotton yarn, was in progress. This work has since been completed and is described in this note.

α- and β-amylose content.—The importance of the determination of the relative contents of α- and β-amylose components of the granules of the various starches has been shown by a number of investigators and has been concisely described by Thurber.[3] It appears that starches with the same relative contents of these components exhibit similarities in other properties, *e.g.*, adhesiveness of pastes and type of dextrine formed on partial hydrolysis. Accordingly, a study of the determination of the components of the water caltrop starch was made. The common procedure followed for separation of the components is first to disintegrate the starch granules and then to subject them to the influence of an electric potential difference in an electrophoresis cell when the negatively charged α-amylose acid radicals migrate towards the positive pole. For the disintegration of the starch granules dry powdered starch (25 gm.) was heated for 8 hours under constant stirring with 90 per cent. alcohol (25 c.c.), ammonium sulphocyanide (20 gm.) and distilled water (100 gm.). Frequently, the paste was tested under the microscope and when the gelatinization was found to be complete, it was allowed to cool and ammonium sulphocyanide was removed (tested with ferric chloride) by constant washing with 90 per cent. alcohol and grinding in a ball mill for about 60 hours. The washed starch was filter-pressed and allowed to dry under vacuum. The separation of the α-amylose component was carried out in an electrophoresis cell similar to that described by Taylor and Iddles[2] and Thurber.[3] A 220 volts potential difference was used. The percentage of α-amylose component recovered was 4·27. This is higher than that of the potato starch and much lower than that of the maize starch. The β-amylose content of the water caltrop starch is nearly as high as that of the white potato starch. It may be concluded that like the potato starch this starch can be used also for sizing purposes.

Penetration and coating power.—The relative penetrating and coating power of water caltrop, potato and maize starch pastes with respect to cotton yarn was compared by a method similar to the one described by Thurber.[3] Threads of No. 30 cotton yarn (stretched on wooden frames) were dipped for 3 minutes in starch paste (4 per cent.) prepared by heating starch suspension in water for 30 minutes at 98° C. and after brushing off excess of starch they were dehydrated with alcohol of graded strengths (30–90 per cent.) and embedded in colloidin-paraffin. The various cross-sections obtained are given in Fig. 1. The dark outer portion

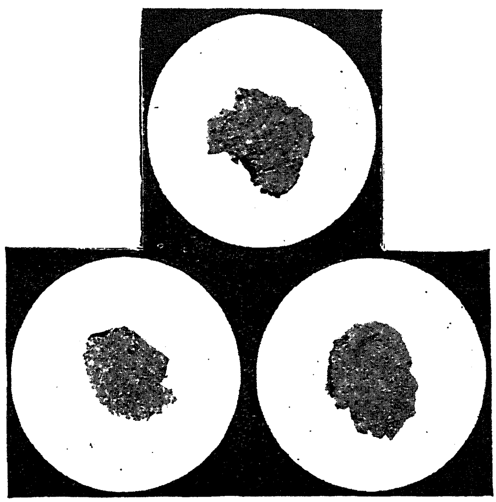


FIG. 1

Cross-sections of thread showing relative coating and penetrating power of maize, potato and water caltrop starches.

marks the extent to which the starch has penetrated the thread. They show that the coating and penetrating power of the water

caltrop starch is better than that of maize and potato starches.

J. L. SARIN.
R. L. SEHGAL.

Government Industrial Research Laboratory,
P.O. Shahdara Mills,
Lahore,
February 28, 1940.

[1] Sarin, J. L., and Mohd. Shafi, *Ind. Eng. Chem.*, 1937, **29**, 1436.
[2] Taylor and Iddles, *ibid.*, 1926, **18**, 713.
[3] Thurber, F. H., *ibid.*, 1933, **25**, 565.

On the Inter-dependence of Transpiration Rates of Leaves on a Plant

IN a paper entitled, "March of transpiration of a leaf since its measurable stage to its fall",[1] P. Parija and B. Samantarai have recorded a very interesting observation that when a leaf (attached to the plant) was enclosed in a chamber through which only dry air (0% relative humidity) was passing, its transpiration rate showed fluctuations correlated with changes in the relative humidity of air outside. They concluded, therefore, that this influence of humidity was exerted through other leaves (non-experimental and exposed to humidity changes of the outside air) and that "all the leaves of a plant are connected into an organic whole so that they influence each other in their activities, specially transpiration". This is evidently an important observation and the writer was, therefore, interested in examining the data more closely. An inspection of the curves of transpiration rate and relative humidity did not reveal a striking relationship of any type and it was thought necessary to examine the data statistically by calculating the correlation coefficients which are given in Table I.

As the transpiration rate of the same leaf was observed throughout its life the linear trend of transpiration rate with time was eliminated and partial correlation coefficients between transpiration rate and relative humidity are given in the table. It will be noted that in no case does the partial correlations approach the significant values ($P = 0{\cdot}05$) given in the last column. Moreover the partial correlations are positive in two cases (Appendices II & IV), which is contrary to expectation as the transpiration rate varies inversely with the relative humidity. It is hoped, therefore, that the authors will confirm this observation by more substantial experimental evidence.

TABLE I

Plant	Data from Appendix	Humidity conditions inside the chamber	Partial correlation coefficient	Partial correlation coefficient at 5% significant level
Helianthus annus ..	I	Not controlled	−0·311	0·444
Datura alba ..	II	,,	+0·283	0·455
,, ..	III	Controlled	−0·243	0·380
Ixora undulata ..	IV	,,	+0·225	0·304

Lyallpur,
November 27, 1939.

R. D. ASANA.

[1] *J. Ind. Bot. Soc.*, 1939, **28**, 65.

"Ascu" Wood Preservative

I HAVE read with interest your two articles on the above subject in the January and February issues of your *Journal*. I am extremely glad to hear that there is "widespread interest" in the difficulties encountered with this wood preservative, and some good will have been achieved by this publicity if the attention of Ascu users has been drawn to the fact that the *Ascu Record* has been withdrawn pending republication in a revised form. I would, however, like to draw your attention to the fact that the reasons for its withdrawal were clearly stated in the note announcing its withdrawal, and this correspondence apears to have arisen chiefly because in your editorial of January 1940, you were not able to publish the note in full.

The most important point connected with the withdrawal seems to have escaped your notice and also that of your correspondents. It is that the withdrawal was necessary, not so much as the result of the large-scale failures with Ascu-treated poles in North India, *but in order to prevent such failures in future*. The Forest Research Institute knows only too well that the failures in North India were due, in large part, to inadequate treatment, but it has not been made clear in your editorials that inadequate treatment might result from failure to evaluate intelligently some of the information given in the *Ascu Record*.

From some of your remarks it would appear that this Institute has already condemned Ascu *in toto*. This is a totally incorrect conception of the present position. What we are trying to do is to prevent future users from repeating the mistakes which have been made in the past, and if these mistakes were due in any way to some of the information given in the *Ascu Record*, the only safe procedure was to withdraw the *Record* for revision and thereby help to prevent further mistakes being made.

You say in your editorial for February 1940 that, "the withdrawal of the *Ascu Record* at this stage leaves the users of the process in a very difficult position". I am unable to agree with this contention. All users of the preservative are, I hope, sufficiently intelligent to realise that inadequate preservative treatment is false economy, and in the withdrawal notice we clearly indicated what we considered to be a reasonable and at the same time an adequate treatment. This information, as was stated in the withdrawal notice, is based on an assessment of the information available up to the present time. The users of Ascu should, therefore, find themselves, not in a "difficult position", but in a much safer position than they were formerly, and should on the whole, be pleased to have some more reliable and more up-to-date information to work on than that given in the *Ascu Record*. The readers of your *Journal* will be the first to appreciate that no invention or process can be good for all time, and that modifications are bound to be necessary as experience accumulates. The Forest Research Institute has always made it clear that the final word on Ascu had not been spoken, but one or two illustrations relative to the present discussion will perhaps make the reasons for the withdrawal of the *Ascu Record* for revision more clear to your readers.

The originator of the process mentioned in the *Record* that "any illiterate *mistri*" could work an Ascu-treating plant. This has been found by experience to be incorrect, and it was largely due to ignorance of the difficulties encountered in practice in obtaining adequate treatment that the North Indian pole failures occurred. One of these difficulties (not mentioned in the *Ascu Record*) is that connected with the changes, both in composition and concentration, which takes place in Ascu solution as the result of wood coming in contact with it. These changes vary with different species, and with some species have been found to be very considerable, with the result that the composition and concentration of the treating solution in the service tank may be entirely changed after one treatment, so much so in fact as to make the old treating solution almost worthless. Again, the originator of the process recommended a treatment consisting of a fairly

low pressure maintained for about 15 minutes. This treatment has been found to be insufficient in practice to obtain complete penetration and good absorption, even in the perishable sapwood, of some species, and it is certainly not sufficient to obtain complete penetration and adequate absorption in the heartwood of several perishable woods. Other new factors, some of which are mentioned in the withdrawal note, have also come to light as the result of experience. These new factors were not known when the *Ascu Record* was published, but the North Indian pole failures brought out the fact that they might be serious. They are not connected solely with inadequate treatment, but concern such features as the possible existence in India of arsenic- and copper-resisting fungi, the possible adverse effects of certain soil conditions on Ascu, and the chemical changes of the toxic constituents of Ascu which may take place when it comes in contact with other chemicals present in certain species of wood.

Finally, allow me to make it quite clear that this Institute has not condemned Ascu or discarded it as worthless. This will be evident from the note, which is sent out to all enquirers who ask for information on Ascu. In the Forest Research Institute's opinion, Ascu is an interesting preservative which has certain features not always found in other preservatives, but it is a comparatively new preservative which is continually presenting fresh difficulties, and until these difficulties have been studied and are more fully understood, the Forest Research Institute cannot endorse its use indiscriminately. As soon as it was realised that some of these new factors might be dangerous, and as they were not known at the time the *Ascu Record* was written, it was considered advisable to withdraw the *Record*, and to issue it later in revised form, so as to avoid repetitions of large-scale failures such as those encountered in Northern India.

L. MASON.

Forest Research Institute and College,
Dehra Dun,
March 17, 1940.

A National Research Council for India

THERE can be no two opinions about the need for a National Research Council but in a large country like ours, such a Council cannot function properly unless different Provinces and States (or some other composite units) also effectively organise and co-ordinate their research work and give it a bias towards the applied side. With the organisation of the University of Travancore, the various Scientific Units in the State, which were formerly under the control of different departments such as Education, Public Health, Industries, Agriculture, Public Works, Observatory, have been brought together in the form of a Central Research Institute under the University. A Council of Research has also been formed in which substantial representation has been given to the Development Departments of the State. Research Scholars and Fellows are appointed to investigate problems of direct value to the industry, agriculture and public health of the State. Thus the resources and the talent of the educational institutions are being harnessed for applied Research in collaboration with specialists in Applied Sciences. Sachivothama Sir C. P. Ramaswamy Iyer, the Dewan of Travancore, and the Vice-Chancellor of the University, is the Chairman of the Council of Research.

As long as the relationship between the all-India finances and the Provincial and State finances are in a state of adjustment, it will be better, in the first instance, to concentrate on provincial co-ordination of applied research so that some start is made immediately. The agency or Council which does so, will have to look to provincial finances for support and will concentrate on specific service for provincial interests. These provincial units can be later co-ordinated under a national organisation in course of time.

Institutions like the *Indian Institute of Science* can play a very important part. They should develop the "cell" system of research and investigate utility problems on the requisition of industrialists and various Provincial or State Governments.

An *All-India Council of Research* should be our aim but to achieve this object, expediency demands that we should organise the units in the Provinces and States, and on their co-ordinated strength, build the national organisation.

K. L. MOUDGILL.

University of Travancore,
Trivandrum,
March 25, 1940.

THE National Research Council should be formed immediately on the lines laid down for such bodies by other civilised countries. Its constitution should be left elastic in the beginning, so that it might be altered later in the light of experience. India cannot wait indefinitely for an all-round agreement, which would perhaps never be achieved.

It should be an autonomous department of the Ministry of Education. Scientific bodies of an all-India character should be represented on the Council. It should be financed by the Central Government, and should be subsidised by the Provinces and the States. It should place its services at the disposal of all.

It should give a direction to research from the national point of view. For instance, it can publish from time to time a list of research problems of vital importance to the nation for the consideration of research workers all over the country.

It should not interfere with pure research (knowledge for its own sake) which should be left to the universities and learned bodies. It should, however, collaborate with the latter.

The Council should set up various centres of Industrial and Technical Research at suitable places. It should see, however, that duplication resulting in the wastage of national resources is avoided.

The frequent recurrence of war in other countries makes it imperative that India should produce all the possible requisites of modern civilised life. Most of the necessary raw materials are abundantly available in the country. The National Research Council should devote particular attention to making India self-sufficient. The first step should be to develop the production of power, and the manufacture of machinery and chemicals. These are the prime factors of national existence and progress.

M. R. SIDDIQI.

Osmania University,
Hyderabad,
March 15, 1940.

The Rights of Man

THE important leading article on this subject in the last issue of *Current Science* calls for comment and discussion. Such discussion if it is not to be futile must needs soon get down to fundamentals.

In the first place as in every debate we must be clear about our definitions. Mr. Wells is apt to confuse "Homo Sapiens" with "probably arboreal", much as the Psalmist in one mood speaks of man as being evanescent as the "flower of the field" and in another as being "little lower than the angels". The difference surely depends on how far enlightenment has risen in the consciousness of the immediate manifestation of "Man".

"Probably arboreal" voyaging in fear, astride of a log, could have built the "Queen Mary" *had he known enough.* All the principles of engineering, physics and chemistry involved were available, but the sun of enlightenment had only faintly appeared above the horizon of his consciousness.

"Progress" is the revelation of ever present Truth. Because the sun is temporarily behind a cloud it does not mean that darkness must prevail. Twice two remains four.

As has been previously remarked, it seems a pity that H. G. Wells chose for his intellectual discipline the subjects of Geology and Biology rather than the more exact experimental sciences of Chemistry and Physics.

He would then perhaps have seen rather further than he seems willing now to permit himself. Granting his great virtue of honesty, which may protect him from final disaster, it

is to be regretted that his perception is apparently so limited.

There must be some fixed basis of thought if we are to arrive at anything but a sterile scepticism. A child who can multiply accurately up to ten times may not be able to deal with problems in higher mathematics, but without such exact foundation he can deal with *no* problems accurately. There is a story of a missionary who came across a band of jungle people quarrelling over the sharing of a load of pineapples. When he, with the aid of very elementary arithmetic, divided the pineapples among the company in equal shares, he was at once worshipped as a god. He however had not *invented* the multiplication table. There never, in fact, has been a time or place where twice two is not four.

It would seem that H. G. Wells like so many others is afraid of *words*.

In his *World Order,* where he expresses a much happier view-point than in *Homo Sapiens,* he speaks of the coming revolution as operating on a very wide front, so that it cannot be said just when and where it is active. One is naturally reminded of an older and more authoritative utterance:—

> "The Kingdom of God cometh not with observation. Neither shall they say Lo here or lo there! for behold the Kingdom of God is within you."—Luke 17:20–21.

So we may well take heart and watch the *thought* of the world.

H. G. Wells graphically describes the accelerated tempo of scientific discovery. We should remember that the starting point of the rapidly mounting graph is to be found in the Atomic Theory of Dalton which made possible quantitative chemistry, and the determination by Joule of the mechanical equivalent of heat, the reasoned consequences of which linked up all phenomena under an exact and *demonstrable* principle.

H. G. Wells makes much of the failure of the churches, confusing "creedal" Christianity with the two fundamental commandments.

After all these two fundamental commandments of Christianity appeal equally to such widely different individuals as Sir William Bragg, President of the Royal Society, and George Lansbury, the Labour Pacifist. "To love the Lord thy God with all thy heart and with all thy *mind*" surely means thou shall love Truth, Wisdom, Justice, Love and Beauty with all thy heart. "To love thy neighbour as thyself" is indeed a commonsense conclusion if society is to preserve itself at all.

Unfortunately the power of words still obtains and "God" to many signifies "the magnified and non-natural man" of Matthew Arnold.

When creedal Christianity is stripped of its false beliefs and pagan elements, just as chemistry shed phlogiston, and physics perpetual motion, and so becomes a demonstrable science, there will be as remarkable an acceleration in the understanding of Reality, as there has been in the knowledge of phenomena.

We may remember that the Founder of Christianity gave his disciples *power* over all evil. This is not merely the negative conception of the "pacifist" or of the disciples of "non-violence", but the actual demonstration of the ever present "Kingdom of God" manifest in the "natural" world.

The many "reforms", which all "men of good will" desire to see, will come as the inevitable outgrowth of this Kingdom, once it is established on a basis of *understanding,* instead of superstition, of creedal beliefs, or of merely personal following.

Mr. Wells himself might feel the sense of "frustration" less acutely if he suddenly realized that a pianist is not called upon to *compose* music of the standard of Beethoven but only to *play* it as nearly as possible as Beethoven would wish it played; and that in the midst of the manifested evil of the present time, we may continue to hear the voice still calling: "Be not afraid of them that kill the body and after that have no more that they can do" (Luke 12:4).

GILBERT J. FOWLER.

Madras,
April 17, 1940.

OBITUARIES

Dr. (Miss) C. MINAKSHI, M.A., Ph.D.

WE regret to bring to the notice of our readers the sad and premature death of DR. (MISS) C. MINAKSHI, M.A., PH.D., Assistant Professor of History, Maharani's College, Mysore University, on the 3rd March 1940, at the early age of 33. Born in a Tamil Brahmin family of Conjeevaram, early in her age she took to study on Western lines, a course which, for a lady, the orthodox Brahminism of her time did not view with favour, but which paved the way for her distinction. After completing her undergraduate studies in the *Women's Christian College*, Madras, she prosecuted her post-Graduate study in History at the Madras Christian College, from which she was the first lady to take the M.A. Degree, which she took with distinction. In recognition of her merit, the University of Madras granted her a scholarship for advanced research in Indian History in 1931 for two years, which was extended for an additional term of a year in consideration of the importance and value of her researches. She selected as her subject for investigation the Administration and Social Life under the Pallavas, including Pallava Art, and the valuable work done by her in advancing the knowledge in the subject earned for her the Ph.D. Degree, a distinction she was the first lady to receive from the University of Madras. A large part of the results of her investigations was published by the University in the form of a book entitled *Administration and Social Life under the Pallavas*, a work which has been well received by the world of scholars and the lay public alike, as bearing a high mark of perfection and scholarship. The Madras University gave her further opportunity to conduct research in other important aspects of ancient South Indian History by granting her a Fellowship in 1937 for a year, an opportunity which she made excellent use of, in investigating into the history of Buddhism in South India. The archæological tours she conducted in connection with her new work, and the discoveries she made, attracted the attention of the Archæological Department of India, who, recognising her capacity and erudition, entrusted to her the task of preparing Archæological Memoirs on the Historical Sculptures in the Vaikuntha Perumal temple and the Kailasanatha temple, Kanchi. It is with extreme regret that we have to note that before the results of her varied researches could be published she has been snatched away from this world.

It is sad to contemplate the qualities of a person who is no more. In the death of Dr. Minakshi, who was known to be a musician of a high order, a scholar at once brilliant, painstaking and conscious, and a lively personality characterised by gentle and straightforward behaviour, South India has lost a distinguished and valuable savant whose life was full of promise.

Professor R. S. TROUP, C.M.G., C.I.E., D.Sc., M.A., F.R.S. (1875–1939)

FORESTERS the world over will mourn the demise of PROFESSOR R. S. TROUP who passed away at Oxford last October, a few months before he was due to retire from the Chair of Forestry. His contributions to the science of Forestry were many and varied and, he was one of the most powerful influences in moulding forestry policy, education, research and organisation within the British Empire.

Troup was educated at Aberdeen and at Coopers Hill where he carried away a number of coveted prizes. Like many another leading Empire forester, he spent his apprenticeship years, so to speak, in India serving in the I.F.S. from 1897 to 1917. After the first nine years in Burma (he had the distinction of preparing the first stock map for a Burma Working Plan), he was selected for Service at the *Forest Research Institute*, Dehra Dun, where his aptitude for sylvicultural research found ample scope for development. Later, he served as Timber Controller to the Government of India during the World War. And, in 1920 he was selected to succeed Sir William Schlich as Professor of Forestry at Oxford. In 1924, he became the Director of the *Imperial Forestry Institute*, Oxford. Professor Troup thus carried the very heavy burden of organising the teaching for the undergraduate and post-graduate forestry students at Oxford, of directing research and of training the probationers for the various Empire Forestry Services and in

every one of these departments he introduced innovations and left the mark of his dominant personality. He was frequently commissioned as an expert consultant on Empire forestry problems, his knowledge of which was probably unique. In the midst of so busy and strenuous a career, he found time to write several books on Forestry, his *magnum opus* being *The Sylviculture of Indian Trees.* He was a regular and prominent member of the Empire Forestry Conferences. He was on the Governing Council of the *Empire Forestry Association* and also served on their Publication Committee.

In 1920, Troup was made a C.I.E. for his services in India. Six years later, a signal honour was conferred on him by his election as an F.R.S. in recognition of his contributions to the Science of Forestry. In 1934, he received the C.M.G.

REVIEWS

Research on Grassland, Forage Crops and the Conservation of Vegetation in the United States of America. By Dr. R. O. Whyte. (Published by the Imperial Bureau of Pastures and Forage Crops, Aberystwyth, Great Britain) (Herbage Publication Series, Bulletin No. 26), 1939. Pp. 113. Price 5*sh.*

It is not very long since the problem of the improvement of grasslands received serious attention. Within the last two decades and a half the progress made has been astonishingly great as a result of the impetus received during the World War. The keen interest taken in this all-important problem of agriculture, since the war is evident in the establishment of an International Grassland Association. Four International Grassland Congresses have so far been held at different places in Europe. And this year in September, the fifth would have been held at Amsterdam, but for the new world catastrophe.

It is but natural, that such a wide problem of great economic importance should necessitate surveys of the work being done in different parts of the world, from time to time. In 1929, Dr. Woodman gave a brief survey of the recent pasture research in Great Britain (*Trop. Ag.,* 6, 12). In 1930, Dr. McConkey of Ontario Agricultural College was commissioned by the Empire Marketing Board to survey and report on "Recent Advances in Pasture Management". This appeared in the form of a valuable monograph (No. 43 of the E.M.B., 1931). In 1934, the Imperial Bureau of Plant Genetics issued a bulletin (No. 14) on "Grassland Research in Australia" and thus carried a stage further the work of survey. And now comes from the same source another valuable bulletin (No. 26) on the recent work in Grassland and Botanical Survey in the U.S.A. Unlike the preceding monographs on this subject, the present one includes in it not only work on the improvement of grassland but also on the conservation of vegetation. It has therefore, an additional value of its own.

A glance at the contents of this bulletin will convince the reader of the magnitude of the work done by Dr. Whyte in providing us with a summary of the work and activities of no less than 46 state research stations spread over the country, and of agricultural and forest services. To present within a short space of hundred pages in a clear form so as to give the reader a true picture of these extensive activities is no easy work. Dr. Whyte has so ably prepared it that he deserves our congratulations.

Attention may be drawn here to some of the salient features of this compilation, especially (*i*) to the organization of the U.S. Regional Research Laboratory, State College, Pennsylvania which will probably be "one of the leading centres throughout the world for the study of the problems of humid temperate pastures"; (*ii*) to the work of Dr. Clements on climax, succession and conservation, which has resulted in the discovery of the fundamental laws concerning the growth of plants in relation to their various environmental factors. Thus it has been found that of the three factors, water, light and nutrients, the first is the most important qualitatively whereas the effect of the latter two is mostly quantitative; (*iii*) to the important section of the U.S. Soil Conservation Service. The problems covered range from

hydrologic phases of farm irrigation and land drainage, revegetation in the great plains, crop-land, orchard, pasture and range management; (*iv*) the survey of the pasture regions of the U.S.A. and the attempts made at improvement of the important types of natural and foreign grasses not only by breeding but by studying their environmental conditions. Thus are evolved varieties of grasses which are (*a*) resistant, (*b*) able to prolong their growth during summer, (*c*) better both from palatability and nutritive points of view and (*d*) resist extreme dry conditions of soil.

In conclusion a word must be said about the importance of this bulletin to India. We hope it will be as widely read as it deserves to be and those at the helm of the agricultural activities in India would try to take the initiative of putting the problem of the improvement of Indian grasslands on a scientific basis by opening special Grassland Research Stations and Provincial Botanical Surveys. Let not the world think that we are slow at taking advantage of the work done in this all-important problem especially at this time when we have at the helm of affairs one who takes so keen an interest in Indian agriculture and who has initiated the movement of cattle improvement. The work so far done in India may be said to touch hardly even the fringe of the work done in the rest of the world. The question of cattle improvement, grassland improvement and conservation of vegetation are concomitant problems and unless and until the latter two problems are solved, the first must remain where it is to-day.

F. R. BHARUCHA.

Garnets and Their Rôle in Nature. Lectures delivered by Sir Lewis Fermor, O.B.E., D.SC., F.R.S. (The Indian Association for the Cultivation of Science, Calcutta), 1938. Special Publication No. VI. Pp. 105. Price Rs. 2–8 or 4*sh*. nett.

To an ordinary student of Geology, Garnet is one of a hundred other minerals which occur in the rocks of the earth's crust and with apparently nothing very special about it; but in the hands of a master geologist like Sir Lewis Fermor, a detailed study of this one mineral in all its aspects can be made to throw light on some of the most fundamental problems in geology. How this is possible has been elaborated by Sir Lewis Fermor in the course of his lectures on "Garnets and their Rôle in Nature" to the Indian Association for the Cultivation of Science, as its Ripon Professor for the year 1937. After giving in his first lecture a full account of garnet as a mineral and its physical, chemical and optical properties, Sir Lewis deals with garnets as constituents of rocks in Lecture 2. The occurrence of garnet in different types of igneous, sedimentary and metamorphic rocks has been noted, and special importance has naturally been attached to its 'chief home' in Nature—the metamorphic rocks. The origin of garnet in these rocks has been fully discussed in the light of recent views expressed by such exponents of studies in metamorphism like Grubenmann and Harker.

The third and last lecture of the series on "The Infra-Plutonic Shell of the Earth and speculations relative thereto" is perhaps the most interesting and thought-provoking. Starting from the ideas reviewed in the two previous lectures, Sir Lewis Fermor here proceeds to point out how they can be used and interpreted to provide explanations of some of the major problems of geology such as, (*i*) the fact that the basaltic lavas of fissure eruptions were probably super-heated, (*ii*) isostatic adjustments of mountain and plain, (*iii*) the explosive origin of deep-seated earthquakes, (*iv*) continental drift and (*v*) the origin of the chondrules of chondritic meteorites. This whole lecture is very fascinating reading and reveals the versatile outlook of its author.

In assessing the value of a contribution on such highly speculative and controversial problems, the question is not whether we are prepared to accept every one of the author's conclusions; what we must recognise is the remarkable way in which starting from known premises, arguments have been developed along a particular line of reasoning, leading to certain important and far-reaching conclusions, which, if not readily and wholly acceptable, are at least worthy of serious consideration. As Sir Lewis himself puts it, Garnet has always been a sort of a 'talisman' to him during the last 25 years enabling him to understand or interpret the speculative aspect of geological studies; and the present lectures embodying his considered views on this subject form a valuable contribution to the progress of geological thought.

L. RAMA RAO.

Practical Microscopical Metallography. By R. H. Greaves and H. Wrighton. Third Edition, revised and enlarged. (Chapman & Hall, Ltd., London), 1939. Pp. 272. Price 18*sh.*

The first edition of the book which appeared in 1924, was intended to provide, within a small compass, a set of typical photomicrographs, suitably annotated, and accompanied by an account of such related matters as might occupy the students devoted to microscopical work. In the second edition several sections were enlarged, especially those dealing with photomicrographic technique, the structure and constitution of alloys, alloy steels, the micrographic examination of steel and of copper alloys, and a new chapter dealing with low-power photomicrography and macrography was added. In the present edition several sections dealing with the structure and constitution of alloys have been rewritten and expanded. Latest developments in illuminants, colour screens, microscopy with deep-blue light and ultra-violet light have been referred to. Some additional photomicrographs taken with new equipments have also been added.

The book is well written and prepared, and should prove useful not only to students of metallurgy but also to engineers and other users of metals who desire to familiarise themselves with the microscopical method of examination. J. S. VATCHAGANDHY.

Elements of Geology. By William J. Miller. Second Edition. (Chapman & Hall, Ltd., London), 1939. Pp. x + 524. Price 21*sh.*

The fact that the first edition of this book published in 1931, has had to be reprinted thrice within the next seven years shows how popular this publication has been among students of geology. The second edition which has been just published has been thoroughly revised and enlarged, embodying a number of features which go to enhance the value and popularity of the book. Being written by one who possesses considerable experience as a teacher of geology, the treatment of the subject-matter is such as to leave a clear and vivid impression on the mind of the student of the facts and phenomena described; and the large number of beautiful illustrations—sketches, block diagrams, and photographs—further assist the student to understand what he is reading about. The first part of the book covering about 275 pages, deals with Physical Geology in all its aspects and gives an account of the various dynamical agents operating on the earth's surface, and the manner and results of their action. The introduction of a chapter on the "Instability of the Earth's Crust" almost at the very beginning of the book is a very good idea since "it is very important that the student should, early in his study of geology, be convinced of the fact that crustal disturbances (often profound ones) actually do take place, because this is one of the most fundamental tenets of the science." The second part which covers another 250 pages, deals with Historical Geology, with reference to North America, and follows the usual procedure of first describing the general principles of stratigraphy and then giving a description of the rocks and fossils of the different periods in their chronological order commencing from the oldest Archæozoic era. A valuable and welcome feature of this part of the book is the large number of palæogeographic maps, based on those of Bailey Willis and Charles Schuchert. Talking about the cause of the Quaternary Ice Age, the author briefly reviews the several hypotheses, and rightly concludes: "We may say that, as is true of so many other great natural phenomena, no one hypothesis or explanation is sufficient to account for all the features of glacial epochs. Probably several or all, or at least parts of several or all, of the above hypotheses must be properly combined in order to explain the phenomena of glaciation, and hence it is more readily understood why great glacial epochs have not been more common throughout the history of the earth."—thus revealing an attitude of mind which all those engaged in the discussion of this and other similar controversial problems will do well to cultivate.

Both in its appearance and the exposition of its subject-matter, the book is neat and attractive.

L. RAMA RAO.

Experiments in Plant Physiology. By W. E. Loomis and C. A. Shull. (McGraw-Hill Publishing Company, Ltd., London), 1939. Pp. 213. Price 12/-.

As the authors of an earlier and more comprehensive work, Drs. Loomis and Shull are already well known to the botanical world. The present work is simpler in scope,

The more difficult experiments have been omitted and some new ones on hormone action included. The authors very modestly call the book as one designed for elementary students only. The reviewer feels that anyone who has intelligently gone through the whole course of exercises (167 in all) will get a good grounding for research work in the subject. There are selected references to original literature, mostly American, and a useful bibliography.

A characteristic feature of the book is that it does not anywhere tell the student what he will find or why. He is given clear and concise directions for the experiments but left to think out for himself the "why" and "how" of the questions that will naturally arise to an inquisitive mind. In other words, he must learn to be his own Socrates. This is bound to be disconcerting to those accustomed to cramming, but the better ones will almost unconsciously acquire a far more thorough understanding of the functions of plants and the principles which underlie their life processes, than they could by merely attempting to memorize a list of facts.

The book is commendable in every way.

P. M.

Practical Chemistry. By N. M. Shah. Fourth Edition. (Students Own Book Depot, Dharwar), 1938. Pp. 69 + iii + 9. Price Rs. 2–4–0.

This is an elementary text-book of Practical Chemistry which attempts to meet the requirements of the science students of the Intermediate course. At the commencement alone, hints about the proper use of apparatus are given and this is followed by a few gravimetric exercises. Next the preparations of a few gases are given, and in the same section the preparation of a few more—methane, acetylene, nitrous oxide, hydrogen chloride—could also have been included. The preparation of certain important inorganic compounds like potassium nitrate, alum, ferrous ammonium sulphate, cuprous and cupric oxides and cuprous chloride might have been included. In volumetric analysis, acidimetry, alkalimetry and oxidation reduction methods alone have been dealt with but the analysis involving the use of sodium thiosulphate and silver nitrate solutions could be included.

A very detailed scheme of qualitative analysis of simple substances has been given at the end, and there is also a chapter on organic analysis dealing with the detection of simple organic substances. Students undergoing training in Chemistry for the Intermediate Examination are likely to find the book quite useful for their course in practical chemistry. M. SESHAIYENGAR.

Intermediate Chemistry—Inorganic and Physical. By Frederick Prescot. (University Tutorial Press, London), 1939. Pp. 828. Price 12*sh.* 6*d.*

This is a suitable text-book of General and Inorganic Chemistry answering to the requirements of the Intermediate students in science and the first year Medical students. The book is divided into two parts. The first part deals with all the theoretical portions and suitably covers the requirements of the B.Sc. pass degree. The chapters dealing with Kinetic theory, Hydrogen-ion Concentration and Colloidal solutions will be specially useful to students of Medicine and Biology. The second part is devoted to descriptive inorganic chemistry and is rightly arranged in accordance with the periodic table. The preparations of important inorganic compounds have been satisfactorily dealt with. At the end of each chapter important questions pertaining to the topics dealt with and occurring in various University examination papers are given. The work is complete and up-to-date and could be read with advantage not only by the Intermediate students and the first year Medical students, but also by those who appear for a B.Sc. pass degree examination. M. SESHAIYENGAR.

Elements of Physico-Pharmaceutical Calculations. Edited by M. L. Schroff and G. P. Srivastava. (The U.P. Pharmaceutical Association, Benares Hindu University), 1940. Pp. 281.

This book is the third volume of the *Indian Pharmaceutical Series*, edited by M. L. Schroff and G. P. Srivastava. Professor Schroff, the author, is a pioneer of Pharmaceutical Education in India, having been largely responsible for the introduction of a course in Pharmaceutical Chemistry in the Benares Hindu University—perhaps the first University in India to institute a course of instruction in this important subject which has been neglected so long. The book consists of several chapters dealing with various branches of Physical Chemistry such as

"Solutions of Electrolytes", "Indicators in Acidimetry and Alkalimetry", "Oxidation and Reduction", etc., followed by two chapters on "Miscellaneous Calculations" and "Evaporation and Distillation". There are also a number of numerical exercises which will be useful to students. The matter is presented in very clear language; but as most of the information given in the book, except perhaps, in the last two chapters, can be found in any standard work on Elementary Physical Chemistry, one wonders if there was any need to add to the already large number of books, good, bad and indifferent, on the subject. The title of the book is somewhat misleading and if a second edition is called for, it would perhaps be advisable to change it to "Elements of Physico-Chemical Calculations for Students of Pharmacy". This will certainly be a more appropriate title than the present one, which, in addition to being misleading, sounds rather clumsy. The book is likely to be very useful to students studying for a degree examination in Pharmaceutical Chemistry.

C. V.

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(1) **Biology for Junior Forms.** By M. R. Lambert. (MacMillan & Co., London), 1939. Pp. 320. Price 3*sh.* (2) **A School Course of Biology.** By L. J. F. Brimble. (MacMillan & Co., London), 1939. Pp. 469. Price 6*sh.*

These two books are published by MacMillan as a course of Biology. Biology is intended to supersede in the schools the old three courses of Natural Science, Zoology, Botany and Physiology. Discarding the method of studying only one or two animals thoroughly, and taking instead a more universal view of plants, animals and man, Biology gives the pupils a knowledge far broader and more useful. Thus the student will leave the school better prepared to face life; and the physical world remains no longer a closed book to him.

MISS M. R. LAMBERT has given in her book an introduction to the study of Biology. Hers is, as a matter of fact, the third of a set of three elementary books on this subject; but as Miss Lambert has written them in the concentric system, the third is by itself a complete introduction to Biology. And it is nothing more than an introduction.

The first part contains general notions on plants, their organs, functions and uses, written with clearness and simplicity. The second part, the most interesting, deals with the chief groups of animals, insisting in each case on the main characteristics of functions and habits. Here we have the best pages about the life, and customs of ants, birds, and spiders. The matter is well chosen so as to impress the young minds with the wonders of nature. The last part gives a few notions of Physiology.

The book is all written with uncommon simplicity of style. Abundance of fine pictures, description of simple experiments, and homeliness of reflections make it very interesting for the young.

Mr. L. J. Brimble's volume is simply wonderful. Although it begins somewhat heavy with long terminology, it becomes, however, soon very interesting. It is a brilliant book, complete, rich and absorbing. The first impression that the many scientific terms might overcome the student is later on corrected by a lighter and attractive style.

The author has avoided division into Botany and Zoology, and has adopted the comparative method. After an introduction to plants and animals (P. I) there follow, in P. II, P. III, the two main subjects: How plants and animals live and how they reproduce themselves. The human being comes next (P. IV) with a splendid chapter on "Man in relation to plants and other animals". In the last two parts the author deals with living things and their environment, and the history of living things. They are really interesting.

The author must be congratulated for his success in bringing out such a beautiful, practical and complete book. With the numerous experiments suggested at the end of the chapters, with many questions taken from examination papers, with his more than 350 fine pictures, the author has given us not only an excellent text-book, but a volume which would find a good place in the home and in any library.

If I may make a suggestion, perhaps a few more notions on edible fruits and medicinal plants would be practical. The diagram on carbon dioxide on page 166 might be made a little clearer. The slip on page 5, where stalagmite is said to be "usually produced by the evaporation of water from a solution of sodium bicarbonate" (it is mainly of calcium carbonate) might be corrected.

F. AIROLDI, S.J.

The Quality of Coke. By R. A. Mott and R. V. Wheeler. (Chapman & Hall, Ltd., London), 1939. Pp. 464. Price 36*sh*. net.

This valuable record of investigations into the properties and testing of coke is really the second Report of the Midland Coke Research Committee of the Iron and Steel Industrial Research Council of Great Britain. (The first Report appeared in 1930 and was published by The Colliery Guardian Coy., Ltd.)

These two volumes undoubtedly stand supreme in the library of the fuel technologist, so far as bibliography of coke is concerned, and the appearance of this second volume is particularly opportune on account of the interest at present taken in the possibilities of Low Temperature Carbonisation in India and of improvement in the quality of soft coke, as well as in the extension of its use as a domestic fuel.

A comprehensive review of this work would itself become a text-book. Space permits of only a brief reference to various important features. It begins by a review of the existing standards for commercial coke, this being classified according to the most important uses. The difficulties facing the investigator in testing cokes for domestic and similar uses are specially referred to. There is an excellent chapter on the whole process of coking, the reader being taken through the stages of pre-softening, decomposition and softening, swelling and agglomeration, solidification and hardening. One statement, on page 16, is of special interest to the Indian Coal Industry. It is to the effect that there is insufficient oxidation during storage of many coals, especially those of high swelling power, even during a year, to affect their properties, whereas the swelling power of low rank coals and their ability to form a strong coke may be seriously impaired by undue length of storage time, it being, therefore unwise to store such coals, especially if of small size, for long periods.

The title might suggest a somewhat restricted scope, but there is a wealth of valuable information, and the research worker will find many unexpected pieces of information and hints for research technique. The rôle of fusain in coke making has in recent years come in for much attention on the part of research workers, and Chapter XIII contains a useful Appendix on the Recovery of Fusain for experimental (blending) purposes as well as on its estimation in coals.

The whole question of blending of coals for coking is also fully dealt with.

Dr. Mott is to be congratulated on the appearance of this additional evidence of his high technical and scientific ability. The diction, systematic arrangement, grammatical style, and method of marshalling facts and arguments are a model for other scientific writers to follow.

Appropriate reference is made to the deeply regretted death of the joint investigator and author, Dr. R. V. Wheeler. C. F.

Life's Beginning on the Earth. By R. Beutner, M.D., Ph.D. (Chapman & Hall, Ltd., London), 1939. Pp. 222. 12*sh*. 6*d*. net.

When did Life commence on this planet? Notwithstanding the tremendous progress achieved by the modern sciences, no definite and fool-proof answer has been forthcoming to this and allied questions—such as: How did Life originate? What exactly constitutes Life? and so forth. Any volume or publication that is likely to throw light on the many complicated problems touching the origin of life is entitled to a sincere welcome at the hands of those interested in scientific pursuits. Dr. Beutner has attempted in the volume under notice, to trace the beginning of Life on this planet strictly proceeding on scientific lines of investigation and depending for verification and demonstration of results on scientific methodology. In the course of a brief "Preface", the author observes that in the year 1933, he ventured on a prophecy that "Life ... in spite of all its complexity, seems to be no more than one of the innumerable properties of the compounds of carbon" (*v. preface*) and claims that within the five years that had elapsed, "part of it has come true". In a virus responsible for the causation of infectious diseases, which marks a living entity and at the same time a substance that can be secured in pure form as crystals, one would readily detect "an enzyme capable of regenerating itself in a natural environment". Such was the discovery made by Dr. W. M. Stanley, of the Rockefeller Institute at Princeton, New Jersey, and Dr. Beutner has attempted a "plain" presentation of all pertaining facts. The "First Approach" examines in detail the phenomenon of Crystallization and its

relation to Living Growth. In the "Second Approach", one is told that Life is just carbon's outstanding property. The "Third Approach" explains that the Ocean is the cradle of Life, and emphasizes the importance of Salt and Water for the growth of Life. In the "Fourth Approach", the view is elaborated that the animal is just a machine. Two brief discussions occur about "Artificial Parthenogenesis" and the "Mitogenetic Rays". Results are summed up in the "Epilogue".

While there must necessarily exist difference of opinion regarding the success of Dr. Beutner and others working in that line of investigation, in rendering an adequate or convincing answer to the permanent and persistent problems—Whence and How did Life Originate? there must be absolute unanimity among scientists in thankfully acknowledging the undoubted value of the author's work as a significant contribution in the direction of finding, if at all it is possible to find any, a solution to the specific problem of the origin of Life. The magic word is ENZYME! Enzymes explain the evolution of Life on this planet. What are these Enzymes? Dr. Beutner remarks perfectly pathetically I should suppose—"... Although 300,000 compounds of carbon have been made, the chemical make-up of the most important substance of the living world, the enzymes is *shrouded in mystery*" (p. 126).

I would like to underline *two* unwritten Laws which sincere and honest scientists should never seek to violate according to Dr. Beutner. (1) Scientists worth their salt should never draw suspicious conclusions as, for instance, "moving oil-drops represent a form of life" (p. 184). (2) Secondly, unverified results should never be published in the lay press, as such premature and preverificational publication of results is sure to lead to universal misconception. In this connection, Dr. Beutner refers to the sensational account published by a reporter of the *Chicago Tribune*, who after a microscopic observation of oil-drops from fresh brain-material, believed that artificial life had been created!

I shall permit myself only one more observation. Dr. Beutner towards the conclusion of his arresting volume remarks that scientists have begun to see life "is not a miraculous separate entity imposed on our earth by a spirit or an *invisible something*" (italics mine). His own attempted explanation carries us no nearer any intelligible solution. "Life", the learned Doctor says, "is one of the developments of the Universe governed by the general laws of Nature" (p. 222). Which, pray, is not such a development? Matter is one such. Life is one such. If Life is explained or interpreted as just a Devil's-Dance of electrons and enzymes, or just a development governed by the Laws of Nature, the explanation bereft of all scientific terminological obscurantism means that LIFE IS LIFE. No critic or reviewer can be blamed if he refuses to evince any enthusiasm over such explanations which are, at best, mere twists in terminology, but, which never succeed in laying bare the HOW of it. Dr. Beutner quotes approvingly the views of a well-known scientist. A modern scientist first of all inquires what precedes a phenomenon to be explained and what follows after it. That would seem to be the essence of scientific explanation. WHAT then precedes ENZYMES? WHAT follows after? I do not believe that Dr. Beutner has rendered direct and straight answers to the cardinal questions. Nevertheless, Dr. Beutner's is a masterly survey of the conclusion of modern Biology, Chemistry, and other allied sciences which makes a bold bid for coming to grips with the problem of the origin of Life on this planet. On this masterly survey laymen and scientists must congratulate him.

R. NAGA RAJA SARMA.

The Criminal in Society—A Review of the *Fundamentals of Criminology*. By Henry T. F. Rhodes. (Lindsay Drummond Ltd., 6, Buckingham Street, London, W.C. 2), 1939. Pp. 280. Price 7*sh*. 6*d*. net.

Since man's adroit attempt to eat the fruit of the forbidden Tree, the problem of Crime and the Criminal has always confronted in systematic social organization, and H. T. F. Rhodes, of the *Institute of Criminology*, University of Lyons (France), and of the *International Academy of Criminology*, has discussed the highly interesting and intriguing question of the possibility of reformation of the criminal with a view to his humanisation. Preliminary definitions and the scope of Criminology are dealt with in the opening chapter. The different schools of Criminology are examined in the next. The Statisticians, The Positivists, The Environmentalists, The

Bio-Sociologists, and the Indeterminists or the Moralists have come in for some searching examination at the hands of the author. "The Criminological Effect" is the subject-matter of the third chapter. What is precisely criminal sociology? What may be the nature, the conditions and the limits of criminal responsibility? What is the significance of Punishment? These questions are discussed fully in this chapter. In the fourth (concluding) chapter, Crime is examined in reference to social order. Authoritarian, Democratic, and Socialist Societies reveal characteristic crimes and criminals, and have adopted corresponding remedial measures.

The problem of Crime and Criminals can be tackled proceeding along different lines of approach. There is the Psychological approach (including the psychiatric and psychopathological). There is the legal approach. Finally, there is the Ethical or the Moral approach. While it is easy to multiply many other approaches, they can all be conveniently subsumed under the three practically universal approaches.

The psychological approach is the most difficult, yet, it is the most interesting. Unless light is thrown on the constitution of the criminal mentality, and unless again the deep springs of action or motives are tracted, it would be impossible to understand crime and criminals. In the first place, it must be remembered that the criminal is *first a human being*, and *only next a* criminal. The sancrosanctity of human personality as such should be respected. Of course, under the storm and stress of modern competitive struggle for existence, and under modern conditions of social organization, those in authority would naturally feel inclined to subject the criminal to summary treatment. A criminal should be summarily clapped into prison or even made to suffer the extreme penalty of law. Secondly, it should never be lost sight of that very often crimes are committed as the results of environmental conditions and circumstances. No scientist will have either the time or the inclination to undertake any metaphysical investigation of crime. Doctrinaire theories and academic discussions are all waste and weariness of flesh. In the concluding sections of his work, H. T. F. Rhodes has sketched the Russian system of employing criminals in constructive work. "Forests were cleared, swamps were drained, ways were blasted through rock, the course of rivers was diverted." All this was accomplished by persons who had been convicted of criminal offences. The Canal joining Leningrad with the White Sea was constructed by convicts (p. 261).

Quite apart from superficial diagnosis and superficial remedies, the problem of crime and the criminal is basically psychological and philosophical. There is no escape from a certain amount of metaphysics and philosophy! Do the criminals elect out of their own freewill to embark on a calculated career of crime simply for the cruel pleasure of it irrespective of other considerations? Or, money and wealth being foundational factors of society, are crimes committed by some simply because, they are unable to get enough wealth by other pursuits? The *Gita* raises the question in a pointed manner. "*Atha kena prayuktoyam papam charati poorushah Anicchannapi varshneya baladiva niyojitah.*" Why does a person commit sin? Why even against his own liking as if driven and goaded by extraneous agent or agents? The Lord answers that ultimately all sins, all crimes are due to psychological motives. "*Kama esha krodha esha rajogunasamudbhava.*" *Kama* or desire, and *Krodha* or ire are responsible for all sin and for all crime. Even the most healthy person has within his body the germs of destruction! That is the law of life or law of Nature. In that way, even the best and most efficiently organized social order contains within itself criminals.

Professional politicians and legislators will find the volume of H. T. F. Rhodes most stimulating and suggestive. The criminal must be given a chance to turn a new leaf. One is bound to come across confirmed criminals of habitual anti-social activities. It is indeed most difficult to deal with hardened criminals, but, even the most hardened criminal is a human personality. Legislators should not lose sight of this fact. H. T. F. Rhodes has laid under contribution practically the entire range of relevant literature on crime and criminology, and, I heartily commend his voume to all interested in the problems of crime, criminology, and prison-reform.

R. NAGA RAJA SARMA.

PLEISTOCENE GEOLOGY OF INDIA

BY

D. N. WADIA

NO geological system in India has a fuller or more varied development than the Pleistocene, representing every aspect of the last chapter of the earth's geological history, geophysical, biological, as well as meteorological. It covers, along with the Archæan rock-systems recording the first pages of earth-history, more than three-fourths the extent of India, the remaining twelve geological systems occupying barely one-fourth the land surface of the country. With over 250,000 square miles of the North Indian plains covered under the river-deposits of this age up to a depth of several thousands of feet, fringed in their northernmost edge by a belt composed of the uplifted bottom of this alluvium—the Siwalik foothills—there are ample materials for a thorough study of the period of geological history immediately preceding the present age—the age which brought Man for the first time on the stage of the earth. To this material has to be added the long stretches of contemporaneous Ice Age deposits in the middle and higher Himalayas, and lacustrine, littoral, lateritic and sub-aerial accumulations, bearing traces of the life of the time in other parts of the country. Pleistocene and Sub-recent ossiferous gravels, over 3,000 feet deep, have been observed in an alluvial basin in the Upper Sutlej in Hundes and doubtless there are a few other sites, hitherto unknown, of equally promising nature. But, so far these widespread records have remained but partly investigated by the geologists of the country and are awaiting more spacious times and a largely expanded corps of geologists, both official and amateur, for their fuller study. The geologists of the Geological Survey of India, in their pre-occupations with the more insistent duty of working out the older formations, capable of yielding results of economic, mineralogical and palæontological value, have felt compelled to put off the detailed examination of this latest rock-formation, which though full of interest, has but an academic interest for the most part and is of no direct use in solving the structural and stratigraphic problems. The present writer well remembers the temptation of spending more time in the detailed mapping of the glacial, lacustrine, and sub-aerial surface deposits of the North-Western Punjab and Kashmir, a temptation which could only have been indulged in at the sacrifice of more urgent basic studies and which was therefore rightly held in check by the senior members of the Party. Pre-history and Archæology have taken a few strides in this country during the last few years, but the dream of the Indian palæontologist that the widely dispersed Upper Siwalik outcrops and synchronous deposits, such as the older river-terraces, gravels, loess, etc., may some day yield the remains of early Pleistocene man—a sivanthropus, has yet remained unrealised.

Geologists, geographers and anthropologists in India must be grateful to the sponsors of the De Terra expedition sent out to India in 1935 for the specific purpose of unravelling Pleistocene history of Stone Age man in India and of studying the Pleistocene Ice-Age cycle in Kashmir. The expedition was organised under the joint auspices of the Carnegie Institution of Washington, Yale University, Cambridge University, and the American Philosophical Society and was under the direction of Dr. Hellmut de Terra, in association with T. T. Paterson and P. Teilhard de Chardin. In a sumptuous volume lately published,* of 354 pages, beautifully illustrated by 56 full-page plates and numerous line drawings, the results of the work carried out are given to the scientific public. The authors have dealt with the large amount of the materials collected (with the help of three able Indian collaborators, Messrs. Sen, Aiyengar and Krishnaswami) and the record of investigations during the ten months of actual field work in India with fulness and lucidity. The major part of the volume, 252 pages, is given to a discussion of the various Ice-Age deposits, their classification and correlation at different centres in South-Western Kashmir. This section contains a descriptive account of the prominent glacial features of large areas of Kashmir territories from the

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* *Studies on the Ice-Age in India and Associated Human Cultures.* By H. de Terra and T. T. Paterson. (Carnegie Institution of Washington), 1939. Pp. 354 + Plates 54.

Ladak and the Upper Indus Valley to the water-shed ranges of the Sind and Lidar, the hill-State of Poonch and the Pir Panjal range, that picturesque and extremely well-defined range in the middle Himalayas, which, besides presenting most interesting tectonic problems, offers a wide scope for further detailed glaciological studies. De Terra postulates four distinct glaciations in Kashmir during the Pleistocene, separated by three interglacial stages, of varying intensity and duration, with at least one prominent post-glacial Ice-advance. In this, he more or less upholds the views of Dainelli (the results of whose work in the Upper Indus region were published in 1922 and 1935), though he does not accept Dainelli's dating of the major events in the glacial cycle. De Terra correlates the first two glacial periods with the three Upper Siwalik stages, Tatrot, Pinjor and Boulder-Conglomerate, and with the Lower Karewas of the Jhelum basin, while the two later Ice-advances he considers contemporaneous with the four prominent river-terraces of the major Kashmir valleys and with the Upper Karewas. In describing this glacial sequence, the four distinct advances and retreats of ice, a vivid picture is presented of the great Karewa Lake of Kashmir which filled almost the whole of the Upper Jhelum basin and remained intermittently in existence from the early Pleistocene to the end of the second interglacial and whose disturbed stratified deposits of clays, marls and moraines bear witness to the momentous movements of uplift of the Western Himalayas, to the extent of several thousand feet, during the early and middle Pleistocene. A detailed account of the petrology of the Karewa sediment, their climatic and genetic significance is given by P. D. Krynine. The microscope has revealed a profusion of diatoms in some clays interbedded with lignite layers of Lower Karewas, while pollen of several genera have been found in the silts. To the already long list of dicotyledonous plants of modern aspect hitherto known several new forms have been added. Elephant, deer, fish and fresh-water molluscs, mostly belonging to living species, and some human artefacts are the principal animal fossils discovered by the party from the Karewas.

Sixty pages are devoted to the Pleistocene geology and palæolithic culture of North Western Punjab (Potwar and Salt Range mountains) where an interesting suite of Chelleo-Acheulian implements (in which the pebble-tools and cores preponderate) have been discovered, including many from a still lower horizon that is taken to be the top-beds of the Boulder-conglomerate stage of the Upper Siwaliks. Paterson discusses the archæology of these finds and classifies the cultures as *early Soan, late Soan, Chauntra industry,* etc. The classification and stratigraphy of the Siwalik sequence of Potwar are treated at some length, the correlation of the various series and stages adopted by the authors being in some respects at variance with that adopted by the Geological Survey of India, especially in the definition of the Pliocene-Pleistocene boundary, the age of the Dhok Pathans and the age of the topmost Siwalik zone.

The Pleistocene stratigraphy of the older alluvium of the Narbada valley and of the Madras coastal plain and their palæolithic industries are described in two brief chapters. The relations of the interesting new implements, discovered by members of the expedition from these southern areas, with the stages of the Soan sequence as worked out in the Punjab, are discussed.

For a ten months' programme of intensive field-work in a region of such complexity the results obtained by the expedition form an impressive record and the leader and his collaborators are to be congratulated on such a successful outcome of the work. Of course, it would be rash for anyone to say that the classification of the glacial record of Kashmir, or that the proposed correlation of the various glacial and interglacial stages, *inter se* and with the terrace system of the Jhelum on the one hand and with the Upper Siwalik stages on the other, is finally accomplished. No such finality can be claimed for a glacial system displaying such a complex interrelation of geological agencies, climatic, hydrographic and orogenic, as those which again and again disturbed the course of the glacial cycle in Kashmir and produced a puzzling jumble of deposits lying at widely varying levels. The present writer, for instance, is unable to accept the correlation of the Boulder-conglomerate horizon with the second glaciation as anything more than provisional, or that there is any appreciable proportion of moraine blocks in the coarse bouldery gravel which composes it. It appears to him likely that the considerable body of residual gravels capping this conglomerate at Jammu and Rawalpindi has been

included in the latter. The rather precise affiliations of the various river-terraces to the glacial stages may also on more detailed investigations prove to be hypothetical in several cases. But, as a foundation for future work and as a suggestive guide to it, much has been done to stimulate and help future workers in this field.

In the dating of the Dhok Pathans and the Upper Siwalik stages one stage forward and the placing of the Mid Siwalik-Upper Siwalik boundary so high up as the junction-plain between Pliocene and the Pleistocene, de Terra departs from the work of Pilgrim, Cotter and the present writer with, it appears, but inadequate evidence. A great deal of emphasis is placed on certain minor erosional unconformities and conglomeratic beds in the Dhok Pathan, Tatrot and Pinjor zones.

Recent work in the area between the Salt Range mountains and the foot of the Hazara-Kashmir Himalayas—a terrain of most copious sedimentation—reveals except for a few minor and local breaks, no unconformity or palæontological gap of any significance between the late Tertiary and Pleistocene. On the contrary, the voluminous series of fresh-water and subaerial deposits (17,000 feet thick) bridges the gap, *on the whole* uninterruptedly, from Middle Miocene to Lower Pleistocene. A number of small local breaks and discordances, due to contemporaneous erosion, do occur in the sequence and make a striking show, as indeed one would expect in a zone of active aggradation by the vigorous, repeatedly rejuvenating streams descending from a tract of recent elevation. The Middle Siwalik, broadly speaking, grades off into the Upper Siwalik without any but a few minor breaks which, however, are sporadic and disappear when followed laterally. The main unconformity of the area is post-Upper-Siwalik denoted by an unconformable overlap between the Upper Siwalik and their overlying Sub-Recent river alluvia. But, this too is not a *hiatus* of any regional importance, tending to diminish in the Soan Valley. At least 10,000 feet of sediments intervene between the Dhok Pathan stage (Pontian) of the Upper Middle Siwalik and the Boulder-Conglomerate stage, the topmost stage of the Upper Siwalik in the Soan Valley. From the palæontological work of Pilgrim in this area based on his three decades' research on the fossil bovids, pigs, giraffes and carnivores, (1911–39) generally corroborated by the detailed mapping of G. de P. Cotter in the years 1926–28 and of the present writer during 1921–25, little doubt now remains that the Upper Siwalik, except perhaps in the very topmost part, is pre-glacial and lies astride the Pliocene-Pleistocene interval of Europe. Indeed the Upper Middle Siwalik and Upper Siwaliks, from the Lower Pliocene upwards, have been grouped together into one unit by more than one observer from the difficulty of separating them by a definite geological dividing-line.

The above, however, are points of comparatively minor disagreements. The authors have fully acknowledged the help they have received from the work of the Geological Survey of India and to the existing literature on the subject. To this literature, the present monograph makes a most useful and stimulating addition.

SILT INDICES AND DISCHARGE ELEMENTS FOR REGIME CHANNELS

Silt Indices and Discharge Elements for Regime Channels—An investigation of the Interrelation of Silt Indices and Discharge Elements for some Regime Channels in the Punjab. By Dr. N. K. Bose and Dr. J. K. Malhotra. (Punjab Irrigation Research Institute, Research Publication), 1939, 11, No. 23. Price Rs. 1–10–0 or £ 0–2–5.

SILT plays a very important part in the economy and the design of a canal system.

For seven years hydraulic data and bed silt samples have been collected from a number of regime channel sites in the Punjab. In 1930 Lacey, based on data from different Provinces in India and Egypt, deduced his formulæ $P_w = 2 \cdot 688\ Q^{\frac{1}{2}}$. This formula has been confirmed with a slight variation of the coefficient as a result of certain definite observations made on suitable channels in the Punjab. In 1932, re-examination of the relation of silt to Hydraulic Data, based on silt particle size, was started and this memoir gives the results of the research.

A channel carries silt in two different ways—the floating silt below 0·05 mm. in diameter and the rolling silt above this size, a silt that hops and rolls and moves slowly as sand dunes on the bed of the canal. This rolling silt really forms the so-called boundary layer of Prandtl between the solid bed of the canal and its flowing fluid. The authors think that the distribution of silt in this layer will really determine the energy distributed in the general body of the fluid and hence determine the selection and slope of the channel.

To give a numerical idea of the various properties of the bed-silt samples "weighted mean-size" and the "standard-deviation" have been used as indices, the former indicates the dominant size, the latter the distribution of other sizes about this size.

The authors found the diameter-size distribution curves to indicate, to a very remarkable degree, the life-history of a channel. Silt samples with almost the same average diameter have very different distributions. These curves for the same channel show a swing of the peak from the left to the right and then from the right to the left, this swing becoming the more pronounced the bigger the channel. The swing seems to be a characteristic of the turbulence of the channel and a study of the curves indicates the probable stability of the channel. The distribution curves of the bed are broadly classified into 3 groups:—(1) Left Hand Type (with peak to the left), (2) Middle Type (no peak) and (3) Right Hand Type (with peak to the right).

Turbulence churns up the whole of the fluid equalising the velocities of the water from one boundary to the other and the middle type of the silt curves indicates a stage in the canal when the churning action is taking place and silts of all grades are made to move on the bed of the canal. During this stage no heavy scouring or setting takes place in the canal. This type has been generally associated with the most stable of channels and when a channel goes off regime these curves become rarer and rarer. Observation also shows that canals in which all the three types occur frequently with no predominance of any one type, will be most stable.

The following three empirical relationships are put forward for the design of a channel, based on the discharge and the silt it has to carry:

$$S \times 10^3 = 2\cdot 09 \frac{m^{\cdot 86}}{Q^{\cdot 21}} \quad \ldots$$

$$\lambda = \frac{R}{P} = \frac{1}{6\cdot 25}\,\frac{S^{\frac{1}{4}}}{m} \quad \ldots \quad \ldots \quad (2)$$

$$P = 2\cdot 8\, Q^{\frac{1}{2}} \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where S is the slope of the water surface measured in feet per thousand feet, Q, the full supply discharge in cusecs, m the average diameter in mm. of the bed silt, R, the hydraulic mean radius and P, the wetted perimeter.

The only quantity difficult to fix is m. It has been found that there is an annual variation in the values of m of any particular channel and this is due to variation of temperature of the water in the channel leading to a corresponding variation in the viscosity of water. This change of viscosity in the boundary layer makes silt particles of the same effective size with respect to diameter fall faster in summer than in winter. Assuming the upward lift of the turbulent eddies moving along the boundary layer more or less to be the same throughout the year, the silt that will be found in motion in the boundary layer will be smaller in size in summer than in winter. The value of m has to be reduced to that of 20° C., the average temperature for the whole year for the whole of the Punjab.

Within the limits of the silt indices calculated for the observed channels it has been found that $P = 2\cdot 8\ Q^{\frac{1}{2}}$ and $R = 0\cdot 47\ Q^{\frac{1}{3}}$ have a very high correlation. It hence appears that within the limits of silt and slope met with in the observed channels, the hydraulic mean radius depends more on the discharge than on other elements.

To determine the value of m at any point of a system knowing the value of m in the river at the point from where the canal takes off it is proposed to commence an investigation of a whole canal system and carry out laboratory experiments on the silt-selective capacity of different outlets and heads. It is also proposed to study the effect of moving silt on the regime of a channel supported by laboratory observations on a tilting flume to correlate different grades of turbulence with bed silt movement.

The results of these investigations will be awaited with interest.

C. GOPALAKRISHNAN.

THE DIAMAGNETISM OF THE MOBILE ELECTRONS IN AROMATIC MOLECULES*

CONSIDERABLE progress has been made during recent years in our understanding of the structures of aromatic molecules and in particular of benzene. From the application of quantum mechanics, and detailed investigations on the Raman and infra-red spectra of benzene and its deutero-isomers, it is found that one electron in each carbon atom in the ring is mobile and is more or less free to migrate from atom to atom over the whole of the ring. These mobile electrons have interesting magnetic properties, not dissimilar to that of free electrons in metals.

Many properties of metals are explained satisfactorily on the assumption that a certain number of electrons get detached from their atoms and are free to migrate from atom to atom throughout the metal. These electrons can be regarded as forming a free-electron gas but their spin-susceptibility is limited by the degeneracy prevailing at all ordinary temperatures, and is given by $k_p = 3/2 \, \frac{n\mu^2}{kT_0}$, where T_0 the degeneracy temperature $= \frac{h^2}{8mk} \left(\frac{3n}{\pi}\right)^{2/3}$. Contrary to the classical theory, the free-electron gas can also exhibit a diamagnetism, as shown by Landau, of value equal to $\frac{-n\mu^2}{2kT_0}$ (when $T \ll T_0$). It is difficult to verify this Landau's diamagnetism particularly on account of the predominant paramagnetism with which it is normally associated. In the case of graphite, however, conditions are favourable for such a verification, as here the spin moments of the electrons are paired to give zero paramagnetism and the restriction of motion of electrons practically to the basal plane has effectively lowered the degeneracy temperature to 520° K. Experimental values beautifully confirm Landau's theory with one electron per carbon atom free to move about in the basal plane.

The occurrence of such mobile electrons is characteristic of all aromatic molecules and is an essential feature of the quantum mechanical theories of the structures of these molecules. Their mobility is a necessary consequence of the uncertainty principle according to which the larger the region assigned to these electrons, the smaller would be their kinetic energy. The actual structure of the aromatic rings is that obtained by "resonance" between a number of canonical structures. An important consequence of the freedom of the mobile electrons to move from atom to atom over whole rings, as in benzene, naphthalene, etc., is the abnormal diamagnetism perpendicular to the plane of the ring.

When these magnetically anisotropic molecules are arranged in a regular manner as in a crystal, the crystal as a whole will naturally exhibit an anisotropy, whose magnitude will depend upon the anisotropy of the individual molecules and on their orientations relative to one another. Where the magnetic constants of the molecule are already known, magnetic studies on the whole crystal enable us in favourable cases to obtain useful information about the orientations of the molecules in the crystal lattice. Conversely, when molecular orientations are already known from detailed X-ray studies, the principal magnetic constants of the molecules can be calculated with high accuracy. Such calculations for a large number of aromatic molecules show that the diamagnetic contribution due to the mobile electrons is roughly proportional to the number of benzene rings in the molecule. Other conjugated molecules with plane ring structures such as cyanuric trichloride and phthalocyanines also show diamagnetic anisotropy, and sometimes, as in the case of phthalocyanines with a 16-membered ring, the susceptibility normal to the plane is 7 times that for the direction in the plane.

The restriction of the freedom of migration of the mobile electrons in these molecules to the molecular plane is also evidenced by the striking directional variations in some of the optical properties of these molecules. Thus in naphthalene, chrysene, etc., it is only the component of the electric vector of the incident light wave in the molecular plane which is absorbed by the molecule, whereas the component along the normal to the plane is not absorbed.

Pauling has evaluated, adopting a semi-classical theory, the effective size of orbits which the mobile electrons will describe in the plane of the molecule under the influence of a magnetic field perpendicular to the plane and thence the diamagnetic susceptibility. On this view any temperature variation in susceptibility such as is markedly observed in graphite, cannot be explained. This temperature coefficient can however be accounted for quantitatively on the quantum mechanical theory, as due to the change in the energy distribution of the electrons with temperature. According to a theory more recently developed by London, other features such as that the anisotropy of diphenyl is larger than twice that of benzene, are also accounted for.

M. A. G.

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* Summary of Presidential Address,—by Prof. K. S. Krishnan, D.Sc. Physics Section—Indian Science Congress, Madras, 1940.

THE RÔLE OF CHEMISTRY IN FORESTRY*

DR. KRISHNA'S broad survey of the rôle of Chemistry in Forestry was designed to focus attention on the "Vast forest wealth of India which has, hitherto, been only partially utilised for the industrial development of the country" and "the part a chemist plays in developing and exploiting" this wealth. Soil factors and plant nutrition present problems to the chemist ranging from soil productivity to plant hormones. The chemist is also of help to the botanist in identifying doubted species; a striking practical application of such assistance was provided in the cultivation of *Artimesia maritima*. In Forest conservation and protection, the fight against the insect pests which cause untold damage is only possible with the co-operation of the chemist, who has placed in the hands of the entomologist several insecticides, both natural and synthetic. But, it is in the field of utilisation that the rôle of Chemistry is far more varied and extended than in either sylviculture or conservation. Wood is the most important Forest produce. The chief limitation of timber is decay and scientific research has been specially directed to remove this defect. The chemist has made great contributions to the solution of this problem, although the ideal timber preservative has yet to be discovered. Again, the technique of plywood and laminated core construction is entirely dependent on satisfactory glues being evolved by the synthetic chemist.

While the contributions of the chemist in the utilisation of timber have been so diverse, his rôle in the economic utilisation of "Minor Forest Produce" covers a still wider field. The use of the terminology "Minor Forest Produce" is rather unfortunate, tending as it does, to obscure the very great value—both actual and potential—of this group of the forest harvest. "Minor Forest Produce" is at present the cinderella in the realm of forest utilisation. On their own merit, M.F.P. deserve greater care and attention. The objection that the collection of M.F.P. is expensive and undependable, is not insurmountable. There is ample material to be worked up on a "cottage industry" scale. For the proper utilisation of M.F.P., the chemist has to solve the problems on the best and most economical method of extraction of the active principles, the study of the chemistry and constitution of the constituents, questions of drying and storage and many other related problems. The utilisation of bamboos and grasses for paper pulp, the distillation of turpentine from *Pinus longifolia*, of sandalwood oil and to a smaller extent of other essential oils, have been rendered possible by the chemists' activity. Apart from extending this activity, even to retain existing markets requires continuous chemical research to better methods, improved yields, grades and maintain consistent quality. Even what appear at present to be monopolies are not immune to the onslaught of competitors as many Indian products bear testimony. There are large numbers of other raw materials for the production of essential oils, and also, oil-bearing seeds which have yet to be investigated. The same remark applies to tanning materials which add their quota to forest revenue.

India abounds in innumerable medicinal plants and herbs. Most of these drugs, though used from time immemorial in the indigenous systems of medicine, do not find sufficient recognition because correct knowledge regarding their potency, active constituents and pharmacology is still lacking. Of the few that find recognition in the official pharmacœpeas, the wasteful and uneconomic method of exporting the raw material itself prevails. India possesses a variety of soils and climates and, therefore, could easily cultivate and acclimatise a variety of herbs and plants of economic value. Cinchona has thus been introduced into India. Pyrethrum and Derris provide other examples, the former having been introduced as an exotic to Kenya, where it has acclimatised itself. In general, the condition of the drug trade in India is unsatisfactory. Some of the difficulties in the way of manufacturing drugs in India can only be remedied, if a regular supply of genuine raw materials of proper quality is assured. Special organisations have been set up for this purpose in many European countries and valuable services have been rendered by such organisations in stimulating cultivation and improving the quality of drugs and the general standard of trade in their respective countries. It would perhaps be advantageous if such an association were to be formed in India also. It is not too early to begin.

* Summary of Presidential Address,—by Dr. S. Krishna, Chemistry Section Indian Science Congress, Madras, 1940.

THE CRETACEOUS-EOCENE BOUNDARY*

"THE study of the Cretaceous-Eocene boundary is a live problem of world-wide interest, and it is likely that studies in India will be of fundamental importance in the elucidation of this problem. We have several areas which offer a promising field for this investigation, and a good beginning has already been made. It is up to us now to pursue these investigations further, and do the best that we can in this fruitful and fascinating field of research"—thus concluded Prof. L. Rama Rao in his Presidential Address to the Geology Section on "Recent Advances in our knowledge of the Upper Cretaceous and Lower Eocene beds of India, with special reference to the problem of the Cretaceous-Eocene boundary."

Reference is made to the recent advances in our knowledge of that great volcanic formation known as the Deccan Trap, with special reference to the age of this formation, and points out how the recent discoveries of fossils in the infra- and inter-trappean beds of different areas clearly indicate at least a Lower Eocene age.

The rich algal flora discovered in the Upper Cretaceous beds of Trichinopoly, Pondicherry and Rajahmundry areas, throws new light on the nature, origin and distribution of Upper Cretaceous and Lower Tertiary algæ in general, and a detailed study of this flora will no doubt lead to results of great value both to the stratigraphical geologist and the palæobotanist. Of particular interest and great importance in the study of the Cretaceous-Eocene transition in South India, is the recent discovery of an Eocene bed in the Pondicherry area, which was hitherto considered as composed exclusively of Cretaceous rocks. It is not unlikely that this will lead to similar finds in the other 'Cretaceous areas' along the east coast of Southern India.

After alluding to the Cretaceous-Eocene transition and associated palæogeographical conditions in India and adjacent countries, based on the recent work done on these rocks in India, Africa, Australia and New Zealand, Prof. Rama Rao has put forward some general considerations of great importance in the proper interpretation of the Cretaceous-Eocene boundary, not only in India but also in the adjacent continents.

* Summary of Presidental Address,—by Mr. L. Rama Rao. Geology Section—Indian Science Congress, Madras, 1940.

THE PLACE OF GEOGRAPHY IN NATIONAL PLANNING*

IN any scheme of planning, the physiography of the country is to be known first, then its soil conditions and vegetation coverings. The geographer is competent to furnish ready information on these points. If all the information regarding the existing conditions be not readily available, a geographical survey of these needs be conducted.

No country in the world needs this kind of survey more than India. Take for instance Bengal, where lands are deteriorating, soils fast losing their powers of productivity, rivers failing to fulfil their task of land-building, marshes and lakes increasing in area at the cost of good arable lands, and a large number of population subsisting on insufficient diet in a pitiable environment. Other provinces are no better, though their problems may be slightly different. For a proper solution of these it is maintained that a stock-taking on a provincial basis is needed in the first instance, that is to say, a geographical survey is to be conducted with a view to studying the economic and agricultural possibilities of the provinces, and furnishing materials on which an edifice of future prosperous India could be built up.

As we proceed from Assam to the Punjab through Bengal, Bihar and the United Provinces, we find that the proportion of irrigated area to the total sown area increases steadily following the decrease of rainfall, being maximum in Sind, where artificial irrigation is practised very extensively. The proportion of irrigated land also increases as we proceed from Assam to Travancore through Bengal, Orissa and Madras. Travancore is one of the rainiest areas of India, and still the area of irrigated land is about one-half of the total area under the plough.

The area of land kept fallow is definitely higher in the lower Ganjetic valley (Bengal) than in the upper Gangetic (U.P.) and the upper Indus (Punjab) valleys. In the lower Indus valley (Sind) the proportion of fallow land to the total sown area is about the same as in the lower Gangetic valley (Bengal). In the zone of maximum cultivation, Bombay and Hyderabad have fairly large fallow lands, but Baroda has none.

Let us now have a look at the population map of the Gangetic plain, the most densely populated region of India. It is clear that the population increases considerably as we proceed towards the plain either from the northern mountainous region or from the southern plateau region. If we carefully examine the map, we find that there is some order in the variation of population in the Gangetic valley, that is to say, area of dense population alternates with area of relatively sparse population. This illustrates the theory of Vidal de la Blache that population does not spread out evenly like oil, but spreads out in swarms like bees.

By synthesising the findings of other branches of knowledge, geography presents a complete picture of the country, which may then pass on to the hands of the

* Summary of Presidential Address,—by Prof. Shibaprasad Chatterjee. Geography and Geodesy Section—Indian Science Congress, Madras, 1940.

planner for re-touching. The rôle of the economist in national planning is not underestimated, but what is claimed by geography is that the geographer can certainly help the economist to keep his feet on the earth. To materialize a scheme of national planning in India, which is the home of one-fifth of the population of the world and where cultivable land per head of population is less than that of other agricultural countries, the starting of an all-India organization for conducting the Geographical Survey of the country, more or less, on the lines of the existing Geological Survey, will be a distinct step forward.

CENTENARIES

Poisson, Simeon Denis (1781–1840)

SIMEON DENIS POISSON, a French mathematician, was born at Pithiviers in the district of Loiret, June 21, 1781. He has recorded an interesting anecdote about his infancy: The infant was put out to nurse. One day his father went to visit his baby. Finding that the nurse had gone to the fields he impatiently broke into the cottage and there saw, with painful astonishment, his darling suspended by a small cord to a nail fixed in the wall to prevent his being injured by the animals in the house. Poisson added, "A gymnastic effort carried me incessantly from one side of the vertical to the other; and it was thus, in my tenderest infancy, that I made by prelude to those studies on the pendulum that were to occupy so much of my maturer age."

After elementary education, he was sent to learn surgery from an uncle of his. "Once my uncle sent me", he says, "to put a blister on the arm of a child; the next day when I presented myself to remove the apparatus, I found the child dead; this event, very common they say, made the most profound impression on me; and I declared at once that I would never be either physician or surgeon. Nothing could shake my resolution, and they sent me back to Pithiviers." There he happened to chance upon a copy of the *Journal de l'Ecole Polytechnique* received by his father and began to solve, unaided, the problems proposed there. This discovered his mathematical propensity. He joined the Polytechnic School at Paris in 1798. His professors discovered his genius and exempted him from the drudgery of the curriculum. This released his energy for creative work and in 1800, he published two memoirs, one on Bezout's method of elimination, the other on the number of integrals of an equation of finite differences. At the instance of Legendre, the latter was published in the *Recueil des savants etrangers*.

This brought him immediately to the notice of Lagrange and Laplace. After the completion of his course, he was appointed repetiteur of his school. In 1802 he was made additional professor and succeeded Fourier as professor in 1806. The following are the posts he held thereafter: astronomer to the Bureau of Longitudes (1808); professor of mechanics (1809); member of the Institute (1812); councillor of the university (1820); and geometer to the Bureau of Longitudes in succession to Laplace (1827). In spite of the stormy days in which he lived he was left undisturbed in his academic career. That is because, Napoleon was wise enough to see that nothing was to be gained by persecuting the harmless academician whose fame he doubtless regarded like that of the other savants of France as an appanage to his own glory. What a contrast to what obtains to-day under the urge of racial and communal hatred!

Poisson's outstanding contribution to pure mathematics is the series of memoirs on definite integrals. His discussion of the Fourier's series paved the way for the classical researches of Dirichlet and Riemann. His memoirs on the calculus of variation and the theory of probability are also worth mentioning. His range in applied mathematics was very wide; electricity and magnetism, heat, gases, capillary attraction and gravitation. In planetory theory he carried forward Lagrange's work on the stability of orbits to the second degree of approximation. Lagrange thought so highly of this memoir that he made a copy of it with his own hand in spite of his old age (1809). What is more significant, it stimulated old Lagrange to write one of the greatest of his memoirs on the same subject. Poisson's well-known correction of Laplace's differential equation for the potential came out in 1813.

On the whole, Poisson wrote about 300 papers in addition to the five treatises most of which were intended to form part of a great work on mathematical physics, which he did not live to complete.

Poisson died, April 25, 1840.

S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

Alcohol Production in Milk.—Only one instance of a yeast obtaining access into milk and causing alcoholic fermentation has been recorded in India. A strain resembling *Torula lactis* was isolated and studied by the author in 1926 from a sample of spoilt milk in Karnal (*Bull.* No. 183, *Agl. Research Institute,* Pusa). The organism was propagated over a long period, but ultimately it died off.

Recently, in the course of an investigation on the bacterial flora of *dahi* from the Bangalore District, some *dahi* was left overnight at room temperature (76° F.) in a glass-stoppered bottle. The stopper was found to be blown off the next morning owing to the production of carbon dioxide and the product had a pronounced alcoholic odour.

A plate culture on brom-cresol purple lactose agar from the sample of *dahi* of the previous day, showed white colonies of a butyrous consistency, which appeared to be yeast cells. The colonies changed the colour of the agar from purple to yellow owing to acid production. The organism was isolated in pure culture and when inoculated into sterile milk and incubated at 30° C. for four days, it produced about 2 per cent. of alcohol without curdling the milk. The organism is being studied as regards its fermentative reactions and morphological characteristics.

C. S. RAMAYYAR.

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Sulphur and Thionyl Iodides.—The existence of sulphur and thionyl iodides has been the subject of much controversy. The recent work of M. R. A. Rao (*Proc. Ind. Acad. Sci.,* 1940, 11, 162) has definitely established that these compounds are produced when dilute solutions of the corresponding chlorides in carbon tetrachloride are treated with dry potassium iodide powder under suitable conditions. A solution of sulphur iodide in carbon tetrachloride is yellow in colour. The compound decomposes rapidly in presence of light. The decomposition is favoured by a rise in temperature. Investigations on the kinetics of decomposition indicate that the velocity of decomposition increases rapidly with an increase in the concentration of the sulphur iodide. The reaction of sulphur iodide with aqueous sodium hydroxide has been investigated quantitatively and is found to be similar to that of sulphur chloride with the alkali.

Thionyl iodide is found to be much more unstable than sulphur iodide. Even during the preparation, a portion of the iodide decomposes into sulphur, sulphur dioxide and iodine according to the equation $2\ SOI_2 \rightarrow S + SO_2 + 2\ I_2$. The hydrolysis of thionyl iodide in presence of alkali has been studied and a quantitative interpretation of the products of hydrolysis given. Thionyl iodide is highly unstable in presence of light. It is more stable at lower temperatures. The absorption spectra of sulphur and thionyl iodides have been investigated and the results are in conformity with the analytical data. The method adopted to prepare the sulphur and thionyl iodides, seems to be general in scope and applicable to the preparation of many such unstable iodides.

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Cytogenetical Analysis of the Chromosomes in the Pig.—A clear account of the structure and behaviour of the chromosomes in the pig is given by F. A. E. Crew and P. C. Koller (*Proc. Roy. Soc. Edin.,* 1939, 59, 163). The diploid number is 38 and the two sex chromosomes are unequal, the *Y* being shorter and about 2/3 the length of *X*. It is possible that the centromere in the sexchromosomes is situated between the pairing and differential segments. Regarding the chiasmata it has been noticed that their number does not undergo any change or reduction as meiosis advances, there being no terminalisation. In the five large bivalents the chiasma formation is localised and it has been observed that recombinations of genes in these bivalents are also limited. The case of an individual where a pair of chromosomes was heterozygous for an inversion is also reported.

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Natural History of Lake Vattern.—In a recent number of the *Acta Phytogeographica Suecica* (vol. XI, 1939), Nils Stalberg gives a complete account of Lake Vattern, with special reference to its natural history and vegetation. The Report was intended as a guide to the Excursions of the Ninth International Congress of Limnology, and of the Seventh International Botanical Congress which recently met at Sweden, and embodies all the known information about this Lake, including the author's own researches. The Report begins with a description of the geological history and the topography of the Vattern basin and proceeds to give an account of the Hydrography of the Lake in all its aspects. The latter half of the Report deals with the fauna and flora living in this basin—especially the latter of which several vascular plants, many characeæ and numerous epilithic algæ have been figured and described.

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Biological Standardisation of Gas-gangrene Antitoxins.—The recent *Bulletin of the Health Organisation* of the League of Nations is devoted to the subject of standardisation of *gas-gangrene antitoxin* (*perfringens*). The method in vogue, was subjected to criticism by Prof. M. Weinberg of the *Pasteur Institute* of Paris who observed considerable divergences in the titres assigned to perfringens antitoxins when different toxins were used for assays on mice. His conclusion was that it was necessary to employ a standard test toxin in addition to the standard serum. A critical enquiry into the method of standardisation was undertaken at Buenos Aires, Copenhagen and Hampstead institutes. The results obtained are reported in the Bulletin.

The Bulletin also deals with the question of the standardisation of the *gas-gangrene anti-toxin (Sordelli)*. Infections due to the gas-gangrene represented by the Sordelli bacillus are frequently met with on the American Continent, although very rare in Europe and the elaboration of an international standard preparation and of an international unit for the corresponding serum are justified.

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Rehabilitation of Adult Prostitutes.—The results of the enquiry into the problem of rehabilitation of adult prostitutes carried out by the *League of Nations*, are presented in a recent volume (*League of Nations Publications IV—Social Questions*, iv, 1939, 4, pp. 157). The rescue work carried out by general welfare institutions has been reviewed. Of the large number of prostitutes rehabilitated by these institutions, very little is known about their later career. In the opinion of most of the workers in this line, rehabilitation succeeds with those women who have practised prostitution for a short time. While some workers think that domestic work is most suitable for the rehabilitated prostitutes, others suggest industrial occupation or factory work as the best. Re-entry into normal life is best achieved through a happy marriage and many reports agree that a high proportion of marriages of former prostitutes proves successful. Judging from the actual volume of success achieved by these agencies in respect of the diminution of prostitution, the League's Committee on Social Questions rightly comes to the conclusion that "there are no facts to warrant the hope that measures of rehabilitation, by themselves will ever greatly diminish the number of prostitutes".

G. S. G.

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Ancient Coins Discovered at Taxila.—Two hoards of punch-marked coins, discovered in Sir John Marshall's excavation on the *Bhir* mound, the oldest of the three successive cities at Taxila dating back to the sixth century, B.C., have been recently studied by Mr. E. H. C. Walsh, I.C.S. The results of his study have been published in a monograph issued by the ARCHÆOLOGICAL SURVEY OF INDIA. From a study of the weight of the coins, the conclusion is reached that India must have had, from the earliest times, an independent system of weight. The coins furnish a future standard of reference for punch-marked coins, as the coins extend over a longer period and contain more varieties and are in every respect more complete than the British Museum specimens. Certain minute coins less than 1/5″ in diameter and weighing about 2½ grains, are the most unique amongst the finds.

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Studies on Indian Coals.—Important researches on Indian coals have been conducted at the *Indian School of Mines*, Dhanbad. These include studies on washability and coking, occurrence of sulphur in Indian coals and chemical composition of Indian coal ashes. X-ray studies were also made of vitrain in Indian coals with special reference to coals in the Jharia Coalfield and of the structure of pyrene. In addition, a number of original scientific papers have been published.

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Botanical Survey of India.—The annual report for the year 1938–39 records the efforts made throughout the year to secure specimens of medicinal plant products, plant materials used as vegetable insecticides, etc. Commercial timbers, samples of hand-made and machine-made paper of different qualities have also received attention; in this connection one is tempted to ask if an activity in this direction may not be considered as a duplication of the work carried out by the Forest Research Institute at Dehra Dun.

Systematic botanists have been assisted by the survey and the Herbarium at the Royal Botanic Gardens, has been strengthened by the addition of some 2,000 plants. Special attention should be invited to the investigations on the poisonous plants of India conducted by Col. Chopra and his collaborators.

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University of Bombay.—*Department of Chemical Technology*: The Prospectus and Research Report for 1938–39 of this Department indicate clearly the two important functions which this recently started university department is fulfilling. Advanced training and facilities for research are provided in Textile Chemistry and Chemical Engineering to suitable candidates in order to equip them to occupy responsible positions in industry. The department also acts as a centre of research and analytical laboratory for the benefit of the industries of the Bombay Presidency and is endeavouring to co-operate with mills and industrial concerns in carrying out industrial research on their behalf or investigating any technical problems that may arise in the course of their work. Further, routine chemical analyses of every kind are undertaken on behalf of industry in general. The Department also functions in particular as a test house for the mill-owners of Bombay and Ahmedabad.

The research report has been conveniently divided into four sections dealing respectively with work published, papers forwarded for publication, work completed and research in progress. We are glad to note that a good beginning has been made in the Department by way of subsidised research. Thus "A fellowship of Rs. 100 per month to the University, has been endowed by Messrs. Das & Co., Bombay, for one year in the first instance, for the purpose of investigating certain industrial problems in which they are interested". Such schemes of industrial fellowships at once prove the worth of this progressive department and also its potentialities for the future industrial progress of India.

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Detection of Carbon Monoxide.—The Department of Scientific and Industrial Research has issued a further leaflet in the series "Methods for the Detection of Toxic Gases in Industry" dealing with carbon monoxide. (Leaflet No. 7, published by H. M. Stationery Office, price 1s,

6*d*. net.) Among the industrial situations in which this gas may be encountered in dangerous concentrations are blast furnaces, brick kilns, chemical works, foundries, gas works, coke ovens and lime kilns. Carbon monoxide is colourless and odourless and is, therefore, most insidious in its action. The first symptoms of poisoning are, shortness of breath and palpitation on exertion, accompanied by headache which increases in severity. With increasing intoxication the judgment becomes disturbed and the affected person may not realise his danger. An atmosphere in which a concentration as low as 1 part in 2,000 is present, may prove fatal in about one hour to a person engaged in an active occupation. On the other hand concentrations below 1 in 10,000 may be regarded as relatively harmless for all practical purposes.

The standard method developed for the detection of carbon monoxide in industry consists in drawing samples of the atmosphere under test through a known area of test paper, treated with palladium chloride, at a slow and constant rate, by means of a 5-litre aspirator. This method enables interfering gases to be removed by allowing the sample first to pass through a tube of activated charcoal. Sampling is continued until a stain is obtained on the test paper which compares with the standard colour chart; the concentration present is then determined by comparing the time required to reach the necessary colour, with the times given on the chart. In this way concentrations of 1 part in 500 can be detected in less than two minutes, and of 1 part in 10,000 in half-an-hour. Full instructions for carrying out the test, and the colour chart, are contained in the leaflet.

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Nature announces that **Mr. H. G. Champion, I.F.S.**, has been appointed Professor of Forestry, University of Oxford, in succession to the late Prof. R. S. Troup. Mr. Champion who joined the Indian Forest Service in 1915, has made several notable contributions to sylvicultural research in India. His "Sylvicultural Research Manual for India" which appeared in two parts—the experimental manual and the statistical code—is perhaps the best known among his works.

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Under the joint auspices of the *Association of Technologists*, Bangalore, *The Indian Academy of Sciences*, *The Indian Chemical Society* (Madras Branch), *The Institute of Chemistry* of Great Britain & Ireland, *The Society of Biological Chemists*, India, *The South Indian Science Association*, Bangalore and *The Technical Association*, Bhadravati, a session of scientific meetings was organised during the Easter Week, March 22nd to 26th. In his Presidential Address, **Sir C. V. Raman** dealt with the results of a new series of investigations on the diffraction of X-rays by crystals, carried out at the Indian Institute of Science by himself and Dr. P. Nilakantan. A new type of X-ray reflection has been observed, the discovery of which opens out a fresh approach to the problems of the solid state. A symposium on "Technique of High Temperatures in Industries" was held when Dr. J. C. Ghosh described some successful attempts at improving the calorific value of water gas. Mr. B. Visvanath (Managing Director, The Iron and Steel Works, Bhadravati) talked on the manufacture of refractories and heat insulators, Dr. M. A. Govinda Rau on the economics of high temperature production, Mr. Junnarkar on the potentialities for using electric power for high temperature furnaces, and Messrs. G. B. Shankar and K. S. G. Doss on methods of control and measurement of temperatures. Mr. G. P. Ogale of the Mysore Glass and Enamel Works raised interesting questions regarding the economics of furnaces used in glass industry, and Mr. H. N. Ramachandra Rao of the Government Porcelain Factory discussed the features of an electric tunnel kiln for firing hard porcelain, under construction. Several other papers were presented on different aspects of high temperature work in connection with the manufacture of cement, steel and paper.

A number of original papers were presented on physical and biological sciences. Dr. H. J. Bhaba had an important contribution on the fundamental effect of the spin of an electron on the electro-magnetic radiation. A group of papers on fossil algæ by Prof. Rama Rao and students were highly commended by Prof. B. Sahni who presided on the occasion.

There were three public lectures, one by Dr. Bhaba on "Stellar Chemistry," another by Mr. B. Visvanath on "The Iron and Steel Industry in Mysore" and the third by Sir C. V. Raman on "Glass".

There was a special meeting of the Technologists Associations and an exhibition was organised to bring out the potentialities in the way of manufacture of scientific instruments and industrial plants in the State.

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INDUSTRIAL NOTES

Linseed Fibre Industry in India.—Dr. R. H. Richharia of the *Agricultural Research Institute*, Nagpur, has drawn attention to the possibility of recovering fibre as a by-product from the straw of the linseed plant grown for seed. Experiments conducted in this direction at the *Oil-Seeds Research Laboratory*, Nagpur, financed by the *Imperial Council of Agricultural Research*, have established, beyond doubt, that the Indian linseed plant is capable of yielding a high quality fibre which may provide a basic raw material for the establishment of a number of industries, such as the textile, paper-making, artificial silk and gun-cotton, etc. These efforts have, therefore, opened up a new field of industrial development in this country and it is hoped that the linseed will become more popular, as the fibre will substantially add to the profits from its cultivation. It has been estimated that Central Provinces and Berar alone will produce nearly 10,00,000 bales of 250 lbs. each annually.

"Slops" of the Mandya Distillery.—The "Slops" on analysis gave the following figures

TABLE I

Particulars	Sample A	Sample B	Sample C
Specific gravity	1·032/26·5° C.	1·035/26° C.	1·03/27° C.
Acidity (as sulphuric) ..	0·76 gms./litre	0·80 gms./litre	1·00 gms./litre
Potash	0·588 gms. %	0·62 gms. %	0·65 gms. %
Phosphate	0·113 ,,	0·13 ,,	0·12 ,,
Nitrogen	1·01 ,,	1·12 ,,	1·05 ,,
Unfermented sugars	0·04 ,,	0·06 ,,	0·05 ,,
Ethyl alcohol	0·004 ,,	0·005 ,,	0·004 ,,
Residue on evaporation ..	6·0 ,,	6·7 ,,	6·5 ,,

(Table I) which indicate that they serve as a source of fertiliser for the Irwin Canal area. The Distillery produces about 24,000 gallons of slops in a day. Hence the amount of potash, phosphate and nitrogen available are 2,700 lbs., 523 lbs. and 4,617 lbs. respectively. The acidity of the wash does not matter if the soil is alkaline which is the case in the Irwin Canal area. Hence the Distillery slops could be very well used as a source of fertilizer for the sugar-cane area.

G. NARASIMHA IYENGAR.

Agricultural Alcohol for Motor Fuel.—A nine-page mimeographed publication (No. 886) issued by the *National Research Council* at Ottawa under the title "Agricultural Alcohol for Power Production", deals with the important aspects of alcohol as a source of power. The publication presents data on the quantities of alcohol used for power production in a number of European countries. It outlines the advantages that would accrue to Canada and sets out the economic arguments for and against the encouragement of the use of alcohol as a component of motor fuels. A short discussion of the methods of manufacture and distribution is followed by an account of the progress in other countries in the utilization of alcohol as a motor fuel. This account shows that large sales of alcohol for power purposes have occurred *only* where there is some legal compulsion. In European countries there are heavy import duties on gasoline and home-produced alcohol is exempted from taxation to allow it to compete with gasoline as part at least of the motor fuel supply.

Tin and Its Uses.—The fourth issue of "Tin and Its Uses" announces a new "white-bronze" plating which out-rivals chromium in its resistance to tarnish and is almost identical in colour and reflecting power to perfectly polished silver. Photographs are reproduced which illustrate the brilliance and other attractive qualities of this new finish on spoons, taps, metal tea-sets and car fittings, and it is suggested that it will also find extensive applications in reflectors for optical instruments, headlamps, etc., unbreakable shaving mirrors; shop fittings, and many other ornamental metal wares.

Thick and adherent tin linings can now be applied to large pieces of apparatus used in the food industry, the Review states, as a result of recent improvements in electroplating technique. These thick linings are far more serviceable than the old hot-dipped coatings. Still another application of electro-deposited tin is as a coating on metal surfaces in rubbing contact, such as pistons and piston-rings and bearing surfaces. The tin not only improves lubrication but also eliminates abrasion during running-in processes.

Cotton-Jute Fabric.—Preliminary trials under actual service conditions with Cotton-Jute Union fabric, which is intended to replace flax, have already indicated its suitability for defence and civil purposes. The threatened shortage of flax, 70 per cent. of which comes from Russia and the rest from the Baltic countries, led to a search for substitutes and thanks to the developmental work of the Department of Supply and the Master-General of the Ordnance of the Government of India, the cotton-jute fabric was evolved.

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SEISMOLOGICAL NOTES

March 1940.—During the month of March 1940, three slight and two moderate shocks were recorded by the Colaba seismographs as against seven slight, one moderate and one great shock recorded during the same month in 1939. Details for March 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus
1940		h. m.	miles		miles
March 19	Slight	10 05·9	1170	Hindukush mountains	..
,, 21	Slight	19 23·2	3010	..	..
,, 27	Moderate	18 01·3	5890	..	..
,, 28	Slight	00 45·8	1610	..	..
,, 28	Moderate	21 18·8	3230	10° N., 120° E. (Sulu Sea, off the Philippine Islands)	150 (appr.)

ASTRONOMICAL NOTES

Planets during May 1940.—The only planet favourably placed for observation during the month is Venus which continues to be a brilliant object, conspicuously visible in the evening sky. It is slowly approaching the Sun and at the same time its brightness is increasing. On May 20, the planet will be at its greatest brilliancy when its stellar magnitude is $-4 \cdot 2$. At about this time, it can be seen with the naked eye even during the day, if the observer knows beforehand its approximate position in the sky. Mars is moving eastward in the constellations Taurus and Gemini and, although decreasing in brightness, will be visible in the evening sky as a ruddy star of the second magnitude. It will set about three hours after the Sun. Jupiter and Saturn will be morning stars and, being close to the Sun, are not well situated for observation.

Nova Monocerotis.—This nova which was mentioned in last month's report, appears to be very slowly fading; an observation of April 8 indicates its magnitude to be 10·1. Some details of the star are given in U.A.I. Circular 808. From an examination of the photographs of the region taken at Sonneberg prior to the outburst, Dr. Hoffmeister concludes the nova to have been a star of the 16th magnitude, subject to some small fluctuations in brightness.

Distance of the Centre of the Galaxy.—There are certain regions close to the plane of the Milky Way where a large number of external galaxies are found. These have been called galactic "windows"—regions where very little space absorption can exist. A study of the cepheid variables in these fields is useful in obtaining reliable estimates of galactic dimensions. The variables in one of such areas have been investigated by Prof. Shapley (H.R. 158) and a new determination of the distance of the galactic centre has been obtained. The computed distance is 9,700 parsecs which appears to agree fairly well with the estimates derived by methods based on different considerations.

T. P. B.

MAGNETIC NOTES

March 1940.—Magnetic conditions during the month were much more disturbed than those in the previous month. There were 2 days each of *very great* and *great* disturbances, 6 of *moderate* disturbance and 12 of *small* disturbance as against 1 of great disturbance, 2 of moderate and 24 of slight disturbance during March 1939. The number of quiet days during March 1940 were 9 as against 4 during the same period of 1939.

The most disturbed day during the month was the 24th, while the quietest was the 15th. The distribution of dates of different characters, is shown in table below.

Quiet days	Disturbed days			
	Slight	Moderate	Great	Very great
4–7, 10, 11, 15, 17, 22	1–3, 8, 9, 13, 14, 16, 18, 21, 27, 28	12, 19, 20, 23, 26, 30	29, 31	24, 25

There were three magnetic storms during the month of which 2 were of great intensity and one of very great intensity, as against two storms, one of great intensity and the other of moderate intensity which occurred during the month of March 1939. The storm of very great intensity occurred on March 24, 1940, and caused considerable interruption to telegraphic traffic all over the world. A detailed description of this storm appears elsewhere in this issue.

The mean character figure for the month is 1·03 as against 0·97 for March of last year.

M. R. Rangaswami.

ANNOUNCEMENTS

A limited number of copies of the photogravure reproduction of the portrait of Sir **Frederick Gowland Hopkins, O.M.,** painted for the *Royal Society* by Mr. Meredith Frampton, A.R.A., is available and the *Royal Society* believe that many friends and admirers of Sir Frederick Gowland Hopkins will welcome the opportunity of acquiring these at a price barely covering the cost of the extra printing and delivery. Those requiring a copy should apply to the Assistant Secretary, The Royal Society, Burlington House, London W. 1., with a cheque or Postal Order for 2 *Shillings*. Not more than one copy will be supplied to one applicant.

It is proposed to hold the **Seventh International Congress of Agricultural Industries** in Rome in 1942. Further information regarding the Congress will be published in due course.

The **Association of Surgeons of India** offers an annual prize of Rs. 100 to the best essay based on original work on a selected subject. The subject for 1940 is:—"Blood Changes in Surgical Inflammations." The competition is open to all qualified medical practitioners registered in India, who have been in practice for *not more than 10 years* after qualification.

The essay should reach the Secretary before the 1st December 1940.

Further details regarding the prize can be had from the Secretary, *Association of Surgeons of India,* Binfield, Kilpauk, Madras.

Those interested in cotton research will be glad to know that **Dr. H. C. Harland** is now in Peru, S. America. His present address is Dr. H. C. Harland, Director, Institute of Cotton Genetics, Sociedad Nacional Agraria, Lima, Peru.

* * *

We acknowledge with thanks the receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 51, Pt. 3.
"Journal of the Royal Society of Arts," Vol. 88, Nos. 4552–56.
"The Philippine Agriculturist," Vol. 28, No. 10.
"Monthly Bulletin of Agricultural Science and Practice," Vol. 31, No. 2.
"Allahabad Farmer," Vol. 14, No. 2.
"Biochemical Journal," Vol. 34, Nos. 1 and 2.
"Biological Reviews," Vol. 15, No. 1.
"The Journal of Chemical Physics," Vol. 8, No. 2.
"Journal of the Indian Chemical Society," Vol. 17, No. 1.
"Chemical Products," Vol. 3, Nos. 3 and 4.
"Experiment Station Record," Vol. 82, Nos. 1 and 2.
"Indian Forester," Vol. 46, Nos. 3 and 4.
"Transactions of the Faraday Society," Vol. 36, No. 227.
"Indian Farming," Vol. 1, No. 2.
"The Review of Applied Mycology," Vol. 19, No. 2.
"The Bulletin of the American Meteorological Society, Vol. 21, No. 1.
"Indian Medical Gazette," Vol. 75, No. 3.
"Nature," Vol. 145, Nos. 3667–72.
"Occasional Notes," No. 7 (Dec. 1939).
"Sky," Vol. 4, No. 4.
"Science Forum," Vol. 5, No. 1.

ACADEMIES AND SOCIETIES

Indian Association for the Cultivation of Science: (Proceedings)

December 1939.—S. M. Mitra: *Raman Effect in arsenates and heat of dissociation of AsO.* Sachindramohan Mitra: *On the influence of foreign substances on the absorption of the dyestuffs in solution.* Rajendralal De: A weak Radio-active substance (preliminary note). N. S. Pandya and P. D. Pathak: *A note on the maintenance of electron emission on Cossor Valves after the low Tension supply is disconnected.* G. P. Dube and H. K. Das Gupta: *On the London-van der Waals forces between two disc-like particles.* D. S. Subrahmanyam: *Pressure waves and boundary surfaces in the free atmosphere.* (Miss) Asima Mookerjee and Jagannath Gupta: *Raman Spectra of Coumarins and chromones.* S. K. Kulkarni Jatkar: *Supersonic velocities in gases and vapours.* Md. Salaruddin and B. G. Narayan: *Unusual Solar Activity.*

Indian Academy of Sciences:

March 1940. SECTION A.—M. Akram, R. D. Desai and A. Kamal: *Studies in naphthalene series—Part I. Some properties of 2-acetyl-1-naphthol and the synthesis of 2-ethyl-1-naphthol.* N. A. Choudhry, R. D. Desai and G. S. Sahariya: *Studies in naphthalene series—Part II. The synthesis of the* trans-*form of* trans-*decalin-2-carboxy-3-acetic acid.* M. Akram and R. D. Desai: *Studies in naphthalene series —Part III. Properties of 4-acetyl-1-naphthol and the preparation of 4-ethyl-1-naphthol. Part IV. The preparation and properties of 2 : 4 diacetyl-1-naphthol and 2-acetyl-4-propionyl-1-naphthol.* M. R. Aswathanarayana Rao: *Investigations on the iodide of sulphur—Part I. Formation of sulphur mono-iodide. Part II. Rate of decomposition and spectroscopic studies.* Sulphur monoiodide is formed in carbon tetrachloride solutions, when a dilute solution of sulphur chloride is treated with solid potassium iodide. The

sulphur iodide is decomposed by light and heat, but is comparatively stable at low temperatures. M. R. ASWATHANARAYANA RAO: *Thionyl iodide —Part I. Formation of thionyl iodide. Part II. Rate of decomposition and spectroscopic studies.* Thionyl iodide is made in carbon tetrachloride solutions by shaking a dilute solution of thionyl chloride with solid potassium iodide. The thionyl iodide is extremely unstable in presence of light. L. RAMACHANDRA ROW AND T. R. SESHADRI: *Synthetical experiments in the benzopyrone series—Part II. Synthesis of flavono- and coumarino-7:8-furan-β-ones and their derivatives.* K. SUNANDA BAI: *Raman Spectra of some carboxylic acids.* Isobutyric, benzoic, cinnamic and lactic acids as well as ethyl lactate have been studied. Changes in Raman spectra with temperature and state of aggregation have been investigated. B. DAYAL SAKSENA: *Raman effect and crystal symmetry.* Using a purely geometrical reasoning, it has been possible to write the tensor components for all vibrations belonging to any point-group of the crystal classes. The results are compared with the experimental data in sodium nitrate and good agreement between theory and experiment is observed.

March 1940. SECTION B.—(MISS) P. R. PARUKUTTY: *The myxophyceae of the Travancore State, India.* C. SURYAPRAKASA RAO: *The myxophyceae of the Delhi Province, India—I.*

Indian Chemical Society:

December 1939.—PRIYADARANJAN RAY AND PHANINDRA NATH BAGCHI: *Complex compounds of Biguanide with Bivalent Metals—Part I. Copper Biguanidines.* PRIYADARANJAN RAY AND NIHAR KUMAR DUTT: *Complex compounds of Biguanide with Tervalent Metals—Part VI. Cobaltic* tris*Biguanidines.* PRIYADARANJAN RAY AND HARIHAR PRASAD BHATTACHARYA: *Complex compounds of biguanide with tervalent metals—Part VII. Cobaltic* tris*Phenylbiguanidines.* B. N. GHOSH AND P. C. ROY: *Comparison of the Cataphoretic and Electro-osmotic methods of measuring electrokinetic potential.* DUHKHAHARAN CHAKRAVARTI AND JYOTIRMOY DUTTA: *Synthetical experiments in the Pyrone series. Attempted oxidation of chromanones with selenium dioxide—Part I.* P. M. BARVE, V. C. VORA AND B. N. DESAI: *Mutual coagulation of colloidal solutions. Interaction of copper ferrocyanide with ferric hydroxide, thorium hydroxide and ceric hydroxide.* PRODOSH CHANDRA ROY CHAUDHURY: *Chromium chromate.* BAIDYANATH GHOSH: *Vitamin C and Toxins—Part IV. The Effect of tetanus toxin on vitamin C metabolism.* K. M. CHAKRAVARTY: *Catalytic formation of methane from carbon monoxide and hydrogen—Part VI. On the poisoning by carbon deposition.* JAGDISH SHANKER, PRABHAKAR N. BALJEKAR AND MATA PRASAD: *Space group determination of the crystals of melamine.* P. C. MITTER AND PHANINDRA CHANDRA DUTTA: *Studies in long-chain acids—Part II. On aleuritic acid (I).* (LATE) N. W. HIRWE AND K. N. RANA: *On chloralamides. The reaction of phosphorus pentachloride on chloral-chlorosalicylamides and their methyl ethers and the reactivity of the chlorine atom.* G. GOPALA RAO AND W. V. SUNDARA RAO: *Mechanism of the microbiological oxidation of ammonia—Part II.*

January 1940.—BAWA KARTAR SINGH AND TARA PROSAD BARAT: *Studies on the dependence of optical rotatory power on chemical constitution —Part XVII. Nitro and Carboxyaryl derivatives of stereoisomeric methylenecamphors.* MUHAMMAD QUDRAT-I-KHUDA AND SUBASH KUMAR GHOSH: *Stereochemistry of monocyclic rings—Part I. Interconversion of methylcyclohexane into methylcycloheptane ring and synthesis of 4-methylcycloheptanone.* H. A. SHAH AND R. C. SHAH: *C-alkylresorcinols—Part IV. Nuclear methylation of 4-acyl-resorcinols.* S. M. SETHNA AND R. C. SHAH: *Pechmann condensation of methyl β-resorcylate with some β-ketonic esters.* H. A. SHAH AND R. C. SHAH: *Furano compounds—Part I. Synthesis of Furo-3′-methyl-5:6-(4′:5)-coumarin and Furo-3′-ethyl-5:6(4′:5′)-coumarin.* PRAFULLA KUMAR BOSE AND PHANIBHUSHAN DUTT: *Natural flavones—Part IV. On the constitution of erianthin, the yellow colouring matter of* Blumea eriantha *DC.* PRAFULLA KUMAR BOSE AND SACHINDRA NATH DUTT: *Investigation of the oil from the fruits of* Ferula alliacea, *Boiss.* W. V. BHAGWAT: *Application of Beer's Law of Absorption to solutions.* S. S. DESHPANDE, W. V. BHAGWAT AND C. W. SUBNIS: *Velocity of transformation of 1:3:5-triketones into 2:6-disubstituted γ-pyrones—Part I. Velocity of transformation of acetone dioxalic ester into chelidonic ester.* DUHKHAHARAN CHAKRAVARTI AND NARENDRALAL DUTTA: *Synthesis of coumarins from o-hydroxyl-aryl-alkyl ketones—Part III.*

Meteorological Office Colloquium, Poona:

March 5th.—DR. K. R. RAMANATHAN: *Ozone and its distribution in the upper atmosphere.*

March 12th.—MR. C. RAMASWAMY: *On Deppermann's memoir on some characteristics of Philippine Typhoons.*

March 19th.—DR. S. K. BANERJI: *Criteria for stability of the atmosphere from Dynamical considerations.*

ERRATA

Vol. 9, No. 3, March 1940:—

(1) Contribution entitled "Calcium Utilisation from Green Leafy Vegetables", p. 124, second column, first line: *For* "the skim milk", *read* "its".

(2) Contribution entitled "Kostanecki Acylation of Orcacetophenone", page 118, lines 13 and 14: *For* "Orcacetophenone and its monomethyl ether on benzoylation gave", *read* "Orcacetophenone on benzoylation gave".

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CURRENT SCIENCE

Vol. IX] MAY 1940 [No. 5

A BUREAU OF STANDARDS FOR INDIA

II

As we have pointed out, in our previous issue of *Current Science,* industrial standardization, which started with the introduction of technics and scientific methods in industry, was accelerated by the economic pressure in producing countries and by the way in which standardization provided an easy remedy for some of their difficulties. Standardization by companies (of their products and processes of manufacture), which started in the latter half of the last century, was extended into standardization by groups or associations towards the beginning of this century. Experience showed, however, that in order to obtain full benefit from the process standardization must be undertaken on a national basis. At present not only is standardization in industrial countries being introduced on an inter-industrial basis but attempts are also being made to bring about international co-operation in the field as far as possible.

The main interests affected by the introduction of standardization in industry are: (1) Producer, (2) Distributor, (3) Consumer. The Government of the country being generally the largest consumer of goods and being responsible for the economic development of the nation cannot of course be left out. The fact that these interests are closely interlinked is not always easily recognised, the consumer does not usually recognise the benefits of standardization and considers it as a problem for the producer. The consumer's engineer very often assumes an uncompromising attitude by specifying

unique equipment or machinery, and is unwilling to sacrifice the latitude of his wide choice in favour of standardised goods for the sake of what he thinks to be the benefit of the maker. On the other hand a producer who has secured precedence in the market may sometimes run after the fallacious idea that he can bind down the customers by supplying them with unique or special types of products which are not available elsewhere. Thus there is a possibility of lack of understanding not only between users and makers but also between makers themselves. The chief difficulty of the problem lies in setting up machinery that would harmonise the various interests and operate for the common good. One obvious solution would be to set up an agency controlled by the Government to deal with the problem of standardization in industry. But it must be remembered that the technical and the scientific world is becoming so complicated and the controlling factors in industry so diverse that to come to any impartial decision which could claim adherence from all, it is but expedient that all interested should have a voice in framing it. In industry standardization is a co-operative movement and cannot be established by law without violating its usefulness considerably. A Government agency with its powers circumscribed by the government restraint and administrating with the help of inelastic legislation is not only likely to fail but may prove a hindrance to the progress of industry. Experience in other countries has shown that a fully democratic organization representing all legitimate interests and claiming no authority except by the merit of its decisions is best able to rally co-operation on all hands and gain public confidence. Added Government recognition would of course bring the security and dignity that are indispensable.

The function of such a body is to simplify, modify and unify the needs of the producer and the consumer with a view to increase the efficiency of production on one hand and ensure the safety and security of the consumer's interest on the other. The work to be done in this connection can be classified under the following heads:—

1. Standardization of quality: this consists in fixing, in definite or measurable terms, such properties of materials as are pertinent to its quality. Uniformity of composition, mechanical strength, etc., may be quoted as instances.

2. Standardization of performance: These specifications lay down in terms which are susceptible to measurement the minimum factors or requirements involving net efficiency, durability, and safety of an appliance under test or working conditions. In the case of electrical machinery the specifications include speed, output, power factor, rise of temperature and several other factors.

3. Standardization of practices: Formulation of codes or regulations regarding construction, installation, maintenance, operation or testing of plant and apparatus with a view to secure safety, uniformity and continuity in working.

4. Simplification: This is intended to bring about uniformity in types, sizes or grades of manufactured goods and to reduce such types, etc., to an optimum number with a view to minimise the waste involved in the production of unnecessary variety of goods, and to secure interchangeability of appliances and component parts.

5. Standard testing: Testing of typical manufactured goods is done with a view to assess the quality of such goods impartially and help the industry by the knowledge so gained in further development and in advertisement.

The outline of the work as stated above may be sufficient to indicate how closely standardization is connected with the scientific development of industry. When organised within healthy limits it is one of the outstanding factors that controls the economic progress of industry. Care must however be taken to guard against premature standardization or over standardization. The general tendency amongst the manufacturers is towards achieving standard requirements more than making new improvements and also towards using all ingenuity in achieving these results by the most economical methods. Secondly forces towards maintaining the *status quo* in manufacturing processes are invariably supported by established custom and vested capital. Standardization therefore if carried out without sufficient safeguards may impede progress or even lead to sterilisation. To derive maximum advantage from standardization in industry it must be based on liberal principles. The following points may be worth mentioning in this connection:

1. Standardization should be based on voluntary co-operation between the various interests.

2. To reach full effectiveness it must be organized on an inter-industrial basis.

3. The number of standards set up should be a minimum and should not change unless a definite improvement on the old one is attainable.

4. Standards must be open to critical surveillance and must be subject to review and revision whenever these are found necessary.

5. As far as possible attempts should be made to level up standards. No recommended standard should prove a hindrance to progress.

6. Standards should be based only on reliable information or observations regarding pertinent factors. Only such factors as are essential to obtain the desired effect should be made mandatory. Freedom in all details and in methods of achieving effects should be given to individuals.

7. If possible all specifications should be made to pass through an experimental stage before they are finally accepted.

8. As far as possible the initiative for a new standards specification should come from all parties interested in it and not from a standards organization.

9. Codes and regulations involving technical details though sometimes national in character should be handled in an advisory capacity.

Organised on these lines standardization has proved a great help to industry, it promotes precision in industry and puts it on a scientific basis, it clarifies the undertaking between the maker and the user and promotes fair dealing.

To the producer, it saves the waste of time and material involved in unnecessary diversity of patterns and sizes of ordinary commodities. It gives him an idea of what the customer expects and enables him to level up the excessive ups and downs in the

market demand by spreading out his production over the whole year. Thus it incidentally helps in reducing seasonal unemployment in industry, it prevents unfair competition amongst producers and puts them on the same level without eliminating the possibility of specialised production, it helps to promote truthful advertising. To the distributor it spares the necessity of keeping large stocks representing so much locked-up capital much of which can never be realised. To the consumer it means less cost, better quality, prompt delivery, interchangeability of appliances, full guarantees from the manufacturers and an immunity from the risk attendant on a novel design. It is a guide to purchase and a reliable basis for comparison of standard tenders. If a transformer of a certain capacity is needed all that the consumer need do is to indicate that the performance of the appliance shall be in accordance with certain known specifications; he receives quotations for a machine of the same guaranteed performance and chooses the cheapest.

To what extent standardization and particularly simplification can be introduced in industry, and to what effect, can easily be seen if we turn our attention to any of the industrial countries, the process for instance has greatly contributed towards the success of the American Motor industry. According to the General Motor Co. of America the 13,000 minor components of which a car is built up are now reduced to only 2,000.

In India industrial activity so far is small and is limited to a few fields such as textiles, cement, electricity, engineering, etc., etc., but judging from the trend of events during the past few years it would appear that the country will soon witness an industria revolution. Whether this revolution come sooner or later it can be said without an hesitation that an organisation to guide th technical and industrial practices in th country is a necessity and will surely b a step in the right direction. We may stat here the following reasons:

1. At present the specifications followe in India are mostly British. Besides these specifications are also issued by Governmer and semi-government bodies to suit the own requirements. We think it is tim these various specifications are co-ordinate and placed on a national basis to su the requirements of the growing India Industry.

2. If co-ordination and standardization introduced in some of the existing industrie such as the electrical supply industry it wi be possible to create a definite market fo a limited variety of goods. It need not b pointed out that this would be a gre incentive to the initiation of new productiv industries.

3. The necessity of a recognised plac which would test the quality and perform ance of industrial products and issue neces sary certificates is being increasingly fel The Government Testing Laboratory a Alipore undertakes such work but its act vity is so far limited.

We therefore suggest that a centr organisation to consider questions relatir to standardization in Indian industry and take the necessary steps to promote su standardization is a necessity. We may al put forward some tentative proposals fo such an organisation.

The aims of the organisation should be (1) to co-ordinate the existing resources to undertake work connected with standardization and to create opportunities for various industries interested in such work to come together and co-operate in the work. (2) To study and co-ordinate the industrial standards followed in the country, to modify the old ones or formulate new ones in the light of the needs of the growing Indian Industry. (3) To work in co-operation with existing research laboratories in India and to secure for the industries the necessary aid to standardize their products. (4) To promote knowledge of national standards in this country and abroad and to act as an authoritative channel of co-operation in international standardization work.

The organisation should be thoroughly representative and may be formed of representatives from (1) leading industrial and commercial concerns and organisations. (2) Research institutions and laboratories. (3) Engineering and commercial associations. (4) Central Government (Department of Commerce, Communication and Central Stores). (5) Provincial and state governments which are interested in the work. The organisation may not have a laboratory of its own; work connected with securing technical data or carrying out investigations to base its recommendations upon can in the initial stages be undertaken in co-operation with public institutions. We may suggest that the Government Testing Laboratory, Alipore, which is already interested in this type of work would co-operate. If necessary some additions should be made to enable it to undertake work of a specialised nature. Standard testing could also be carried out at the same place.

The actual working of such a body should be on the same lines as those of the British Standards Association. A new specification or modification is sponsored by any party represented on the body, after due consultation and agreement with other interests involved. A special expert committee consisting of representatives of all legitimate interests is then formed to study and formulate the proposals and recommend them to the Central Board. The Committee has wide powers and its decisions are accepted except in cases of dispute. Wide publicity is given to the proposals during the committee stage and the next stage when the proposals are published as tentative specifications. Any comments or criticism are carefully considered. The specifications are finally incorporated when they are accepted by all and have proved their suitability.

Expenditure involved in such an organisation is small (only on office accommodation, printing and few experts) and can be met by contributions from commercial bodies represented on the organisation and the various governments.

NON-LINEARITY IN QUANTUM MECHANICS*

BY

B. S. MADHAVA RAO

(University of Mysore, Bangalore)

IT is perhaps the most fundamental principle of quantum mechanics that the system of states forms a linear manifold in which a unitary scalar product is defined, and the linear character of the wave function is the superposition principle which is at the basis of quantum mechanics. Developments during the last few years have however given an indication that one may have to admit the possibility of a future non-linear character of quantum mechanics. The first indications of non-linearity came from the positron theory, and later the avowedly non-linear theory of Born was devised to meet the difficulties of infinite self energy in quantum electrodynamics. Still more recently the question of interaction of mesons with nuclear particles appears to suggest that this interaction may be of a non-linear type.

It is instructive to notice that the two fundamental difficulties of quantum mechanics, *viz.*, the question of divergences, and the problem of the elementary particles can be traced in essence to this question of linearity *vs.* non-linearity, the main difficulty in the latter case being the conception of unification of the different wave equations of the elementary particles, light and heavy, into one comprehensive theory if it is to be linear.

Let us look a little more closely at the type of non-linearity that arises in positron theory, and its connection with the non-linear field theory of Born. The simplest application of the former theory is to the adiabatic insertion of an external field into a "vacuum" which induces a sort of vacuum polarisation, in other words, a charge distribution equivalent to the creation of pairs. The next simple application is the case where the external field is so weak that only first order terms in the field strengths and their derivatives need be retained in the perturbation calculations. In this approximation additional terms appear in Maxwell's equations equivalent to saying that Coulomb's law breaks down for distances less than the Compton wave-length. For higher approximations the corresponding field equations are no longer linear, and the superposition principle no longer valid. This deviation from linearity also gives rise to the phenomenon of scattering of light by light which is explained on the basis of the creation of pairs in intermediate states. These features of the positron theory appear to have a close parallelism with the non-linear field theory of Born. In fact, the concept of vacuum polarisation is inherent in the nature of the latter. Further all calculations made on the assumption of the non-linearity in positron theory show that the field equations can be derived from a Lagrangian which, remarkably enough, has the same form as in Born's unitary theory. A quantitative comparison of the two theories shows that the critical field strength of the positron theory is numerically equal to the field strength on the classical Lorentz theory at the boundary of the electron, and this is also the stage at which the feature of non-linearity set in. It is also necessary to observe a striking difference between the two theories. In the theory of the positron negative and positive masses play symmetrical roles while Born's theory does not envisage negative mass even abstractly. Now, Pauli has recently shown on very general considerations that there is an intimate relationship between spin, and definiteness of charge or energy density. Thus the definition of a definite particle density (4-current) which transforms like the components of a 4-vector is not possible for integral spin, and a positive definite energy density, and also a positive definite total energy are not defined for half-integral spin. These, however, are not positive statements since they do not say that for integral spins there is a definite energy density, and for half-integral spins a definite charge density. In fact, this is no longer the case for spins greater than 1. It is only in the case of the small spins 0, ½ and 1 that such positive statements could be made. Thus the spin ½ is characterised by the fact of the possibility of a definite charge density, and spins 0, 1 of definite energy

* Opening Address at the Symposium on Quantum Mechanics held during the Indian Science Congress Session, Madras, Jan. 1940.

density, and thus these spins are distinguished from all other higher spins. As is well known, Born's theory does not explain the spin of the electron correctly giving integral eigen values for the spin operator. This fact which is in consonance with the energy density being positive appears as a consequence of the fundamental assumption of non-linearity introduced in the theory. On the other hand, the positron theory which explains spin correctly has also non-linear features which appear to have been forced into the theory. Thus, in spite of the similarities between the two theories, it looks as if non-linearity as a fundamental physical principle does not perhaps really go very deep being more in the nature of a mathematical device.

As another example of a theory wherein non-linearity appears as a secondary feature might be mentioned the recent classical theory of the electron given by Dirac. This theory retains Maxwell's equations as they are, *i.e.*, the field equations are linear, and the infinities are avoided by a sort of subtraction formalism of the type used in the positron theory, getting the finite mass of the electron as the difference between the infinite negative mass at the centre, and the infinite positive mass of the surrounding Coulomb field. The equations of motion of the electron in the electromagnetic field, however, come out non-linear in the theory, giving an example of non-linearity of a derived or secondary type.

We might now consider the non-linearity that arises in the theory of the meson in connection with the interaction of mesons with nuclear particles. The meson theory originally proposed by Yukawa for the explanation of the exchange character of nuclear forces is based on the heuristic assumption that nuclear forces can be described by some sort of linear field. The theory has been further refined by the introduction of the vector formalism, but the field is still linear differing, however, from the Maxwell field in two important respects, *viz.*, the meson field itself is charged, and is characterised by a "meson charge" g_1 and a "meson dipole moment" g_2. Thus taking into consideration the mass of the meson we have three essential differences between the theory of the electron and the meson. When the meson theory is applied to the interaction with nuclear particles, as for example, to collision processes with large cross-sections, it appears to break down for distances less than $1/\lambda$ ($= h/\mu c$; μ = mass of meson). There appear terms in the interaction which increase with increasing energy. Connected with the same behaviour of the interaction is the fact that many other effects as, for example, the perturbation of the self energy of the proton diverge more acutely than in ordinary radiation theory. This has led some theoretical Physicists to doubt the correctness of the fundamental equations even for mesons of energy comparable with their rest mass, and to take the position that these facts set a limit to the applicability of quantum mechanics suggesting that the right interaction may be of a non-linear type. However the recent work of Bhabha on the classical theory of neutral mesons, and some as yet unpublished work by the same author on the classical theory of point dipoles seem to suggest that these difficulties are really spurious and arise because of the fact that radiation reaction is not properly taken account of in quantum mechanics. In any case, even if such a non-linear feature becomes inevitable, we should observe that the position regarding non-linearity here is different from that in quantum electrodynamics where the deviation from linear laws are purely of a theoretical nature, and cannot be verified experimentally. Thus all radiation effects of an electron could very well be treated by a first order approximation theory, and there would be no experiments contradicting such a theory. Here the behaviour of mesons in traversing matter provides direct experimental tests for the interaction in question, *i.e.*, the non-linearity is of a determinable type.

Mention might also be made here of another attempt at a non-linear theory based on the idea of a new universal constant like an absolute length or momentum or field strength. Basing his considerations on the fact that one has to rely only on theoretic grounds for introducing non-linearity, Born has recently introduced his principle of reciprocity. According to this, the only natural and unique way of introducing non-linearity into a field theory is that used by Einstein in his theory of gravitation, namely, the postulate of general invariance which leads one to consider space-time as "curved". But Einstein's theory has to do with very small curvatures imperceptible in the region

of laboratory dimensions. It is also clear from the smallness of the gravitational constant that cosmological curvature has nothing to do with atomic effects. These latter are bound to be extremely small, of the order r_0. But small r_0 means large momentum $b = h/r_0$. Born's principle is that the domain of elementary particles has to be considered from the standpoint of momentum-space in which a non-linear geometry with small curvature reigns. The curvature equation should contain solely r_0 and b (or r_0 and h) but not the gravitational constant.

The question whether the linear or non-linear character of a field theory is related to the question of derivation of the equations of motion from the field equations alone might now be examined. For instance, in the well-known Helmholtz theory of vortices in a non-viscous fluid the motion of line-singularities is actually determined by the partial differential equations alone which are there non-linear. In the gravitational theory where also the field equations are non-linear the recent "approximation method" of Einstein-Infeld-Hoffmann shows that such a thing is also possible. On the other hand, in the non-linear theory of Born the equations of motion are not determined by the field equations alone.

Coming to linear field theories we might notice that in ordinary Maxwell's equations in which electrical particles are regarded as point singularities, the motion of these singularities is not determined by the linear field equations. On the other hand, in the recent Dirac theory of the electron the equations of motion, though themselves non-linear, follow immediately from the field equations which are linear.

We have described a number of non-linear theories in some of which non-linearity enters as a fundamental factor, and in some others as a secondary feature. Again in some it is purely of a theoretic origin and in others of a type which can be decided by observation. As regards non-linearity as a principle in theoretical physics it is difficult to say anything in general. Judged by the principle of simplicity linear laws appear to be the most suitable ones, and moreover they have the advantage of uniqueness.

SOIL EROSION CAUSED BY WIND

BY

R. MACLAGAN GORRIE, D.Sc.

SOMEWHERE above the dust, gloom and grit of the dust-storm, the sun is shining. For want of adequate protection on some land surface, the wind has whipped up the loose soil and carried it many miles to make life hideous for the dwellers in some distant city. Somewhere it will come to rest. Somewhere wind-transplanted seeds may lodge and grow, but the sower will not be the reaper.

We have been asked to explain the significance for India of wind erosion. Roughly one may say that wherever there are dust-storms there is wind erosion; a fairly large part of India is suspect, but without a detailed survey of soil behaviour actually under the stress of exceptionally high winds, it is very difficult to give a concise picture of the damage which may be occurring in different parts of India.

In soil erosion caused by water, it is the exceptionally severe storm spread over many hours, but with interspersed intervals of torrential downpour, which causes infinitely more damage than weeks or months of ordinary rain showers. So also in wind erosion, it is the sustained and exceptional storm which does the greatest damage, but here the phenomenon is of very high wind following weeks of drought, and possibly assisted by widespread ploughing operations or forest fires or excessive grazing, all of which leave powdery soil exposed to "dust devils" which carry it into the upper air.

Erosion by water and by wind is frequently found acting in turn on the same patch of ground, but roughly speaking, water erosion is a serious phenomenon on slopes of more than 3 per cent. whereas wind erosion is more prevalent on flat or slightly undulating surfaces. Nature sees to it that where water cannot punish man for his destructiveness and poor husbandry, the wind can do so. A land surface typical of wind erosion is carved out in hummocks of soil, the crest of each rise being built

round some deep-rooted vestige of the previous plant cover. Round each of these centres the wind has picked away the exposed soil until quite deep channels have been formed with scallopped markings on the sandy surface reminiscent of wave action ripple markings on a sea beach. Such a landscape is well seen a few miles north of Campbellpur in the Attock District. In many places where a typical wind erosion landscape has not developed, however, wind erosion may nevertheless be serious, as can be judged from the way wind borne sand and powdery grit accumulates behind Euphorbia and other live hedges. Mr. J. A. Wilson of the Forest Service recently quoted as examples the land along the Coimbatore–Bolanpatti and Coimbatore–Mettupalyam roads, and observant readers can doubtless add their own examples from their own country-side.

The loss from wind erosion is an even more insidious one than in water erosion, for the lightest particles in the soil are inevitably the ones you want to keep, the infinitely small grains of manurial material and partially leached salts. The factors which contribute to the severity of wind erosion are bare earth surfaces of pulverised soil, and a high wind with an unobstructed stretch for it to operate in. Eliminate any of these and the wind cannot collect a large load. First, then, keep the plant cover intact even if it is only an incomplete carpet of bunch grasses. Secondly, where ploughing is to be done, keep your fields under diversified crops in strips set at right angles to the prevailing wind. The actual velocity of the wind cannot of course be controlled, but by ridging the ploughed soil in plough land, soil drift can be greatly reduced. Thirdly, make full use of nature's own prescription by growing shelter-belts of trees and tall grasses.

Possibly the closest study of shelter-belts has been made in Russia, where recent planting under the second Five Years' Plan has amounted to 865,000 acres of shelter-belt, a truly gigantic scheme vying in scope with the American Great Plains Shelter-belt project. The efficiency of these shelter-belts across the wide and wind-exposed plains has been thoroughly tested and measured. They cause a marked increase in productivity in each field in a strip up to 20–25 times the height of the trees in the belt, even when the belt consists of a single line of trees. They not only reduce the extreme severity of the wind and stop it from transporting soil, but the temperature and aridity extremes are reduced so that the crop ripens more regularly. In snowy areas the moisture added to the ground by the deep and regular snow beds in rear of each belt is of the greatest value and contrasts markedly with unprotected land where the snow beats along in a blizzard and eventually leaves much of the ground frozen, uncovered and dry. Similar results are also reported from Canada and Hungary.

Soil is most in danger from wind when it is pulverised and broken down. When its natural aggregation into a crumb structure has been preserved and encouraged by good methods of husbandry, the danger is greatly reduced. When a large flat open area has been badly cultivated and starved of manure so that the crumb structure has collapsed into a friable powder, the wind can produce chaotic damage in a very few days or even hours. The pulverised soil is lifted bodily from the surface of the fields and dumped around obstructions such as hedges, buildings, roads and railways where it is least welcome. The vagaries of such damage are often hard to understand, for the top few inches of fertile soil may be removed from one man's fields while another's field near by is buried under a load of sterile sand. Soil thus lifted up is itself a potential destroyer, for it has a sand-papering effect upon any vegetation standing in its path, and in very severe dust-storms the vegetation may be stripped or browned off almost as if frost or hail had destroyed it.

LETTERS TO THE EDITOR

Magnetism of Phosphors

A STUDY of the magnetic susceptibility by the Curie balance of a few commercial samples of phosphorescent powders indicates an increase of diamagnetism when the powder is rendered luminiscent. As long as the composition of the phosphors remains unknown, the observed variation may be attributed to the existence of some paramagnetic components, whose susceptibility depends on temperature. With the view of eliminating the uncertainty regarding the composition, the calcium "sulphide"—bismuth phosphor was prepared from chemically pure ingredients. 7 gm. of sulphur and 10 gm. of calcium oxide were ground together and heated to redness for about 15 minutes in an electric furnace. 5 gm. of this calcium "sulphide" was mixed with 0·25 gm. of sodium sulphate, 0·15 gm. of sodium tetraborate, 0·10 gm. of calcium fluoride and 0·0012 gm. of bismuth; the mixture, after heating to bright redness for about 25 minutes, yielded the CaS-Bi phosphor which phosphoresces with a blue colour when exposed to light. In fact the luminescence is so strong that the spectrum of the phosphorescent light is clearly visible in a direct vision spectroscope. A magnetic study of this phosphor has revealed that the process of the decay of phosphorescence can be followed from observations on the variation of susceptibility during the decay. Fig. 1 gives the variation with time of the

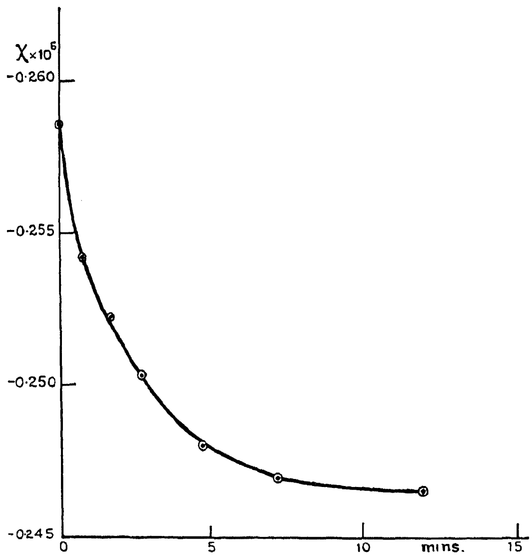

FIG. 1

The variation of magnetic susceptibility of CaS-Bi phosphor during phosphorescent decay

susceptibility of the CaS-Bi phosphor initially illuminated strongly. As the materials utilised in the preparation of the phosphor are all diamagnetic, the observed increase of diamagnetism while luminescent cannot be ascribed to a temperature effect. An independent test has shown that the temperature effect on the magnetism of the powder is inappreciable. According to the view put forward by Lenard,[1] the phosphorescent centre consists of the atom of the heavy metal (Bi) attached to a sulphur atom in the ringlike arrangement of the alkaline earth sulphide (CaS). The increase in the observed diamagnetism while luminescent is on this basis explicable as arising from the larger electron orbits which circumscribe the phosphorescent centre on irradiation; our results therefore lend support to Lenard's view regarding the mechanism of phosphorescence. The earlier results of Rupp[2] cannot however be reconciled with the expectations of the Lenard theory.

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H. S. VENKATARAMIAH.
University of Mysore,
Central College, Bangalore,
April 11, 1940.

[1] Lenard, *Ann. der Physik*, 1910, **31**, 641.

[2] Rupp, *ibid.*, 1925, **78**, 505. (*Vide Physical Principles and Applications of Magnetochemistry* by Bhatnagar and Mathur, p. 158.)

A New Band λ 2963 of the *OD Molecule*

IN a previous letter[1] the rotational structure of the (2,1) band λ2916 of the OD molecule has been reported. Further work on the emission band spectrum of heavy water has revealed the existence of a new band with its head at λ2963, showing doublet P, Q, R branches, characteristic of the electronic transition $^2\Sigma^+ \rightarrow {}^2\pi_{\text{inv}}$. The values of the rotational term differences and the calculated constants indicate that the band corresponds to the vibrational states $v' = 3$ and $v'' = 2$. Attempts are being made to detect the analogous (3,2) band of the OH molecule, which does not appear to have been identified so far in spite of numerous investigations on the emission spectrum of ordinary water vapour.

The calculated constants for λ2963 referred to above are $B_3' = 8\cdot09$, $B_2'' = 9\cdot31$.

The wave numbers of the lines $Q_1(1)$ and $P_1(1)$ are 33702·8 and 33686·9 cm.$^{-1}$ respectively. The analysis has led further to estimate the vibrational constants for the lower electronic state of the OD molecule. From the data for the bands (2,0), (2,1) and (3,1), (3,2) the intervals $\Delta\nu_{\frac{1}{2}}''$ and $\Delta\nu_{1\frac{1}{2}}''$ have been found to be 2632·0 and 2544·5 cm.$^{-1}$ respectively. Hence it is easy to deduce the following values for the vibrational constants,

$$\omega_e'' = 2719\cdot5,\ x_e''\omega_e'' = 43\cdot75.$$

The mass ratio of the hydrogen isotopes estimated from ω_e'' (OD) and ω_e'' (OH) is obtained as $\rho = 0\cdot7281$.

Details of the rotational structure will be published shortly.

K. R. RAO.
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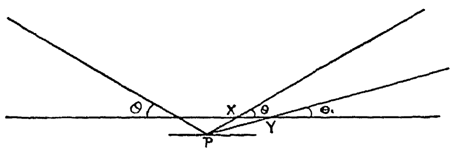
Andhra University,
Waltair,
April 8, 1940.

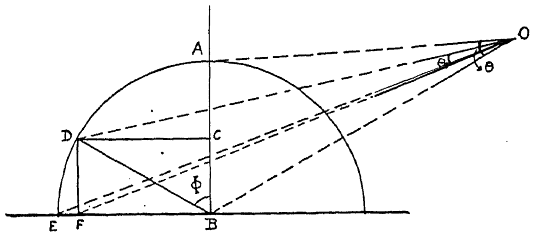
[1] *Curr. Sci.*, 1940, **4**, 172.

Variation of Intensity along an Electron Reflection Ring

IN examining the structure of a polycrystalline surface by electron reflection, the patterns obtained consist of rings in the form of semicircles. The reflected rays lie on a cone with the incident beam as the axis. The electrons reflected along a generator of this cone which lies in the plane of incidence, leave the material by the shortest path; while the electrons moving along any other generator have to travel over a longer distance. Those electrons which travel over a longer distance in the material are absorbed more than those which have a shorter path in it. Thus we can see that the intensity of a ring in a reflection pattern—which is merely the section of cones

of reflection—will be maximum along the planes of incidence, and will diminish as we go further and further away from this plane.





In the figure ADE is the ring, BAO the plane of incidence, DO any ray making an angle DBA $= \phi$, and the angle DOF $= \theta$, the angle of emergence of the ray OD. Since OA lies in the plane of incidence, the angle BOA, the angle of emergence of the ray OA is equal to the glancing angle θ. Further X and Y are the paths travelled respectively by the central ray OA and the ϕ-ray OD, after reflection at P within the material. If we assume that the reflecting block has a flat surface we get from the geometry of the figure

$$\sin \theta_1 = \sin \theta \cos \phi$$

and

$$y = x \sec \phi.$$

It is quite natural to suppose that the electrons like X-rays obey an exponential law of absorption. On this supposition we get

$$I_\phi = I_{\phi_0} e^{-\mu x (\sec \phi - 1)}$$

where I_{ϕ_0} is the intensity for $\phi = 0$. For a definite specimen and a particular ring, x would be fixed and we may write $\mu x = A$, a constant.

In column two of the table are given the values of I_ϕ for different values of ϕ and A, these are calculated on the assumption that $I_{\phi_0} = 100$ in each case. Column three gives the relative intensities obtained with a microphotometer, here also for comparison the values are expressed with $I_{\phi_0} = 100$. The specimen used to produce the pattern was a polished piece of silver etched to give rings. In this case the best agreement between the observed and calculated values of I_ϕ is obtained for $A = 1$. A qualitative consideration of the penetrating power of the fast electrons also shows that A or μx should be of the order unity for 30 K.V. electrons.

TABLE

Angle	I_ϕ Calculated			I_ϕ Observed
	A = 1	A = 3	A = 10	
0°	100	100	100	100
1°	100	100	100	100
15°	97	90	70	98
30°	85	63	22	87
45°	66	29	2	68
60°	37	5	negligible	34
75°	6	negligible		5
80°	1			negligible
85°	negligible			

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May 1, 1940.

The Mechanism of the Persulphate-Alkyl-Iodide Reaction

THE persulphate-alkyl-iodide reaction was found by us to be kinetically of the first order with respect to the alkyl iodide.[1] However, the reaction is not unimolecular, as varying the concentration of either of the reactants produces a corresponding variation in the reaction rates. The persulphate acts not only as an oxidising agent, but also as a catalyst, the potassium ions exerting a primary electrolyte effect.

This reaction cannot be analogous to the reaction between potassium persulphate and

potassium iodide, which is bimolecular. Also, the nature of the primary salt-effect in these two reactions is not similar. Any formation of iodoso or iodoxy compounds is out of consideration as in such a case the reaction would be of the second order. In order to explain the first order mechanism, the alkyl iodide could be supposed to primarily dissociate in one of the following three ways:—

$$\left.\begin{array}{ll} 1. & C_2H_5I \longrightarrow C_2H_5 + I \text{ (radical)} \\ 2. & C_2H_5I \longrightarrow C_2H_4 + H^+ + I^- \\ 3. & C_2H_5I \xrightarrow{H_2O} C_2H_5OH + H^+ + I^- \end{array}\right\} \text{(slow)}$$

After the dissociation, the iodine radical or ion may be oxidised to molecular iodine, which would be a faster process, thus:—

$$\text{I (radical or ion)} + \overset{--}{S_2O_8} \rightarrow \overset{--}{SO_4} + I_2 \text{ (fast)}$$

It is also possible that oxidation of the free alkyl radical may follow the slow dissociation. The most plausible mechanism seems to be (1) followed by comparatively faster reactions as

$$\left.\begin{array}{l} C_2H_5 + O_2 \longrightarrow C_2H_5{\cdot}O{\cdot}O - - \\ \qquad\qquad \text{(very reactive radical)} \\ C_2H_5{\cdot}O{\cdot}O - - + C_2H_5I \longrightarrow \\ \qquad\qquad C_2H_5{\cdot}O{\cdot}O{\cdot}C_2H_5 + I \end{array}\right\} \text{(fast)}$$

Reaction (3) is also probable as dilution with water enhances the reaction velocity. However, if this mechanism were true, addition of an acid should shift the reaction to the left, *i.e.*, in the presence of $H+$ ions, the observed reaction rate should decrease. On the contrary, it has been observed that addition of $H+$ ions increases the velocity to a considerable extent. Therefore, this type of dissociation seems to be untenable. Applying the same arguments, (2) is also out of consideration.

Regarding possibility of (1), after the first stage of dissociation into a free radical, the function of the persulphate may be to oxidise the iodine radical to molecular iodine or the free alkyl radical itself may be oxidised to the peroxide,[2] by the oxygen from the persulphate, as indicated above. If free radicals are involved in the reaction, $H+$ ions may accelerate the reaction unlike the other two suggested mechanisms.

When the reaction was carried out under similar conditions with nitric acid, another powerful oxidising agent, instead of potassium persulphate there was no iodine liberated. Therefore it would appear that this reaction is facilitated by the persulphate ions only. But the iodine from the alkyl iodide is also liberated by the action of H_2O_2. Therefore, it is some common property of $K_2S_2O_8$ and of H_2O_2 (other than that characteristic of the persulphate as an ion) which is responsible for the reaction. And that is the property of supplying oxygen to the free alkyl radicals into the very reactive R.O.O.-radicals which further may react with the undissociated alkyl iodine to form the peroxide, R.O.O.R. The usual method of the preparation of dialkyl peroxide is by the interaction of dialkyl sulphate and H_2O_2.[3] In a similar manner, alkyl iodides may form ultimately dialkyl peroxides by the action of H_2O_2 or $K_2S_2O_8$.

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Ramnarain Ruia College
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V. V. Nadkarny.

March 28, 1940.

1 Telang and Nadkarny, *J. Indian Chem. Soc.*, 1939, **16**, 536.
2 Ziegler *et al.*, *Annalen.*, 1933, **504**, 131, 162.
3 Baeyer and Villiger, *Ber.*, 1901, **34**, 738.

Yellow Mosaic of Bhendi

Yellow mosaic of 'bhendi' (*Hibiscus esculentus* L.) is widespread in occurrence and seriously affects the production of fruits.

The first visible symptom of bhendi yellow mosaic is the clearing of small veins and then of larger veins (Fig. 1). In young leaves these patterns are sharply delineated. The chlorotic areas are at first confined to the veins, but later they extend into the mesophyll and vary in colour from yellowish green to pale yellow. They are not clearly defined, but run out gradually into the normal background of the leaf. There is often a green patch of varying extent in the centre of each area. In badly

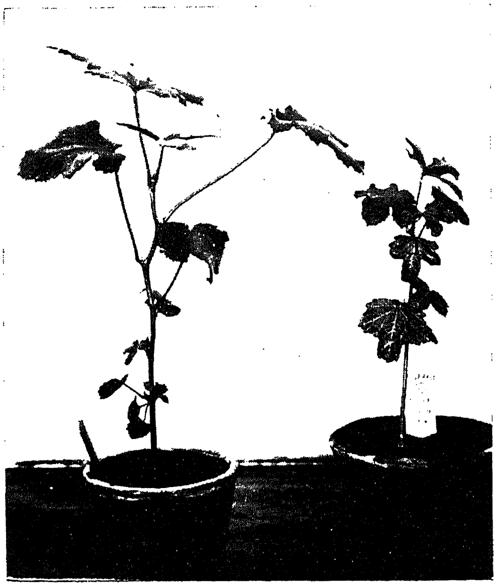

FIG. 1

Left.—A healthy bhendi plant.

Right.—A diseased bhendi plant showing clearing of the veins.

diseased plants, no marked mosaic but only a general chlorosis develops in the young leaves which may or may not show patches of light green. All growth subsequent to infection is dwarfed, the leaves remain small in size and the petioles are reduced in length. Infected plants blossom sparingly and produce few fruits. In nature plants remain susceptible to infection throughout their life. Under the glasshouse conditions, the diseased leaves show thickening of the veins on the lower side; but no foliar growth or enations are produced on the veins.

The virus of yellow mosaic is not sap-transmissible nor is the disease transmitted by the seed. The virus is easily transmitted by grafting.

Insects commonly found feeding on bhendi plants include *Empoasca devastans* Distant, *Empoasca* sp., *Aphis gossypii* Glover and *Bemisia gossypipera* M. and L. In feeding experiments, the first-named three species of insects failed to transmit the disease, but the white-fly, *Bemisia gossypiperda,* always transmitted the virus. The disease developed as a rule in from two to three weeks after the infective white-flies had fed on the healthy plants. The white-flies transmitted the virus of yellow mosaic to hollyhock plants, *Althaca rosea* Cav., and back to *Hibiscus esculentus,* but were unable to infect plants of 'Sakel' cotton.

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April 17, 1940.

The Inheritance of a New Type of Purple Pigmentation Manifesting on the Glumes at Anthesis

THE sorghum plant develops purple pigment in many of its organs. Such pigmentation may develop at various times in its growth. One such organ is the glume. The glumes of the spikelets may or may not develop purple pigment. When they develop it, the commonest experience is for the glumes to emerge green and develop the purple pigment in the later stages of growth, from the dough to the ripe stages of the grain. An exception to this general condition has been noted when African varieties with the glumes emerging purple from the boot were met with. The simple dominance of this character has been reported.[1] In this note we are recording the occurrence and inheritance of a new type of purple pigmentation manifesting on the glumes. In this type, the spikelets emerge green from the boot. The purple pigment begins to develop on the glumes concurrent with the march of flowering. The pigment is of a light tint and anthocyanic. This character is best noticed in the full flush of flowering, when most of the glumes are tinted purple. When flowering is over, this faint purple fades away. This type of pigmentation is bound up with the flowering phase of the plant. When this has developed and faded away, the usual later dough grain stage manifestations of purple pigmentation could occur.

This rare type of manifestation occurs in the group *Sorghum conspicuum,* Snowden, from Tanganyika in Africa. One of the varieties from the Rufigi District in the Tanganyika territory, showed this character. In it, one natural cross occurred (A.S. 5939) without the manifestation of purple pigment during flowering. This was sown and the F_2 gave 134 plants without purple and 48 plants developing purple on the glumes at flowering time. From this an F_3 generation was raised. One selection which developed purple, bred pure. Of the three selections with no purple, one was pure for green glumes at flowering time and the two others segregated giving a total of 258 plants without purple and 88 plants with purple at flowering time.

It will thus be seen that a new gene, African in origin and confined to the group *S. conspicuum* has been met with. The effect of this gene is to develop a light purple pigment at flowering time, vanishing with the end of flowering. This character has proved a simple recessive to the common unpigmented condition. Whereas many dominant genes producing purple pigment in various parts of the sorghum plant and at various times in its life-cycle have been traced to Africa, this African recessive purple pigment gene is of added interest.

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T. Venkataramana Reddy.

Millets Breeding Station,
Coimbatore,
May 8, 1940.

[1] *Curr. Sci.*, 1937, **5**, 590.

The Occurrence and Inheritance of Purple Hairs on the Spikelets of Sorghum

The generality of sorghums are hairy in some part or other of their spikelets. This hairiness shows best on the glumes. The pedicels of the pedicelled spikelets and the callus are generally hairy. The glumes may be glabrous, and when hairy, may vary in the intensity of the hairiness. When most intense, they are felty. When sparse, the hairiness is confined to the top third of the glume, and when sparser still, to a fringe of hairs at the edges. These hairs are usually hyaline. In stray cases these are purple pigmented and show best at flowering time after which the pigment fades away. Purple haired spikelets occur mostly in African varieties. Some Indian varieties and the wild sorghums have also some types with purple-haired spikelets. When the spikelets are hairy, it is usual for the nodal band (the soft tissue at the very base of the leaf-sheath) and the auricular junction (the light-coloured tissue connecting the base of the leaf-blade with the top of the leaf-sheath) to be hairy also; but when the spikelet hairs are purple pigmented, such pigment does not affect the hairs on the nodal band and the auricular junction.

A.S. 4212 is a selection from a North Rhodesian variety and its spikelets have purple hairs. A selection from this, *viz.*, A.S. 5896, which was obviously a natural cross, segregated for this character giving 87 plants with purple-haired spikelets and 31 with hyaline ones. Three purple and one hyaline selections were taken from this family and an F_3 raised. The hyaline-haired selection bred true. All the three purple-haired selections segregated giving a total of 282 plants with purple and 91 with hyaline hairs on the spikelets.

It is thus seen that purple pigmented hairs on the spikelets of sorghum are a monogenic dominant to the usual hyaline condition.

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May 8, 1940.

A Modified Form of Acetocarmine

Belling's Acetocarmine[1] has been of considerable use to cytologists, in the study of nuclear divisions and any extension of its use would be welcome. As Ganeshan[2] has pointed out, there are two sources of trouble in its use. First, acetocarmine deteriorates very rapidly

under tropical conditions, though protected from bright light. Secondly, even when freshly prepared, it does not stain adequately some plant smears. To overcome these disadvantages, the addition of adjuvants to the stain was tried.

One such adjuvant, 'Igepon T', manufactured by the I. G. Farben-Industrie of Germany, was found to be useful, added in this manner. About 0·2 gm. of 'Igepon T.' is dissolved in 45 per cent. aqueous solution of acetic acid and powdered carmine is added while it is boiling. Addition of iron salt to the solution is inadvisable, but if desired the salt might be added after the smear is mounted in this carmine.

The chromosomes take some time to stain, full colour being attained after 10 minutes. Provided the adhesion between cells and slide is good, the smear can be rinsed with rectified spirit, dehydrated with absolute alcohol, cleared and mounted in canada balsam. The cytoplasm can be counterstained with Light Green, if desired. In making the permanent mount, the cytoplasm shrinks appreciably, but not the nucleus.

The addition of 'Igepon T.' checks rapid deterioration of the acetocarmine. (The photograph, Fig. 1, is of pollen mother cells of

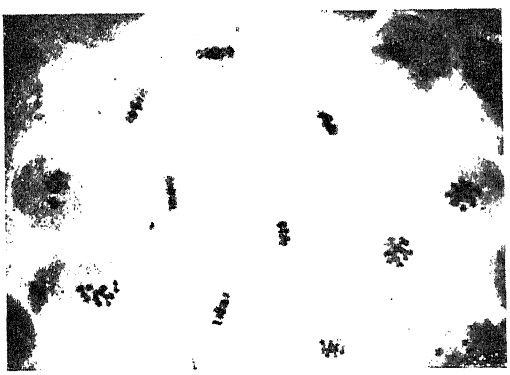

FIG. 1

P.M.C. of Tropeolum in first division metaphase

Tropeolum majus, in the first division metaphase stage, prepared in the above manner with a month old acetocarmine). It appears as if the carmine does not form a true solution in the acetic acid and that the addition of 'Igepon T.' checks the precipitation of the carmine. The adjuvant, however, improves only slightly the staining qualities of the acetocarmine. But if pure carminic acid is used instead of powdered carmine, in the preparation of the solution, the staining qualities are also improved. But the acid is much more expensive than carmine and the colour of the chromosomes, when stained, is a dull brown.

'Igepon T.' is an emulsifier, a synthetic wetting agent of value in dyeing textiles. It is apparently a sulphonated long chain unsaturated fatty acid. Similar products are marketed by a few other dye manufacturers (American and French) under different trade names and are likely to prove just as useful.

S. SAMPATH.

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Benares Hindu University,
Benares,

April 17, 1940.

[1] Belling, J., *Biol. Bull.*, 1926, **50**, 160.
[2] Ganeshan, D., *Curr. Sci.*, 1939, **8**, 114.

A Preliminary Note on the Fission of Vascular Cylinder in Some of the Roots of *Hydrocotyle asiatica*, Linn.

SOME of the old root-bases of *Hydrocotyle asiatica* Linn. show fission of the vascular cylinder and the separated masses of bundles become arranged in a circle as shown in Fig. 1. Serial transverse sections from the tip up to the base of the root with the said cleavage of the vascular cylinder reveal the normal secondary thickening of the dicotyledonous type near the root apex. When traced gradually towards the base, the continuous circular cambium ring becomes constricted into a triangular, quadrangular or pentangular arc, ultimately each arc embracing each of the xylen bundles of the stele.

Similarly, the larger mass of the xylem breaks up into as many smaller bundles as there are primary xylem bundles included in it. Almost simultaneously with the formation of these smaller bundles, they are forced away

from the centre and from one another by the vigorously growing parenchymatous cells which arise from the smaller rings of cambium. Each of these separate bundles, thus formed by the cleavage of the vascular cylinder, looks more or less circular with sufficient secondary growth of wood elements amongst the primary xylem bundle. Rays of parenchyma gradually widening towards the cortex are found in continuation of the primary xylem bundles and groups of parenchymatous cells are seen scattered in the secondary wood elements. The smaller ring of cambium round each of these cleft xylem-masses is circular at first, but in sufficiently advanced stage of secondary growth the cells of the cambium can scarcely be marked out from the remaining portions of the separate bundle. The primary phlœm bundles are found situated at the outer end of the central broad medullary rays just alternating the primary xylem bundles placed towards the centre of the section. Starch grains are deposited abundantly in the parenchymatous ray cells. Phellogen appears in the pericycle inside the endodermis, which extends at first sufficiently only to break up ultimately into numerous segments, their cells having flattened tangentially in the mean time. In the primary tissues of the root the resin canals are found opposite the xylem and the phlœm groups of the primary vascular strands as remarked by Solereder.[1] After secondary growth the resin canals are also seen inside the phelloderm as shown in Figs. 1 and 2. In old root-bases after sufficient secondary growth has advanced, cortex disappears completely from the older part (Fig. 1), though its presence is evident in the younger one (Fig. 2).

Almost similar fission of the xylem was shown by Koch[2] in the mature napiform roots of *Sedum maximum* Sut. of the family Crassulaceæ and its allies. It occurs only in the middle (not in the upper or lower) portion of the roots as summarised by Solereder.[1] In transverse section this region shows a circle of concentric vascular bundles with central wood. Originally the fibro-vascular system of the roots had normal structure. Subsequently, however, the ring of cambium breaks up into a number of separate arcs, which extend round the portions of the original xylem and enclose them in an annular manner. In the family Umbelliferæ according to Ternetz[3] *Azorella selago* Hook. f. exhibits fission of the xylem mass in the older parts of the stem, and in the roots. In the young axis of this plant the vascular bundles are loosely arranged in the normal way to form a ring. In the course of growth in thickness and the simultaneous development of cork, a process of disorganization starts in the parenchymatous groundtissues and in the outer portion of the secondary cortex, both of which become partly transformed into a kind of complementary tissue; at the same time clefts are formed, which have

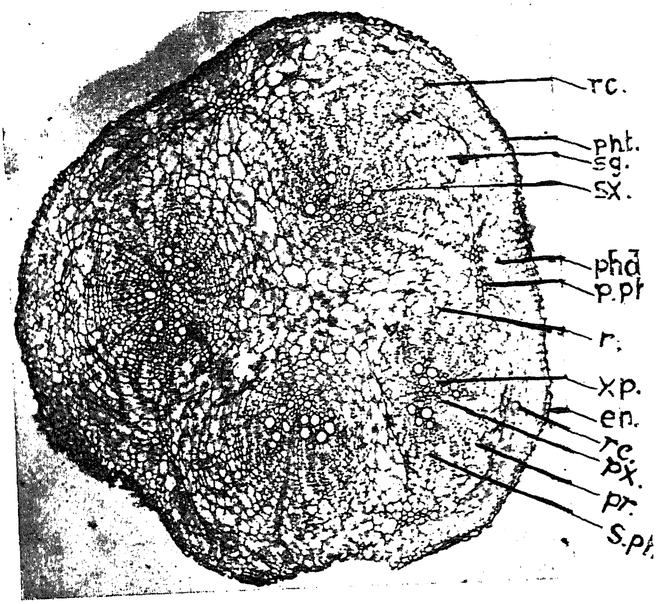

FIG. 1

Transverse section of an old root of *Hydrocotyle asiatica* L. from near the root-base

en.–endodermal cells disorganised at some places; *phl.*–phellogen; *phd.*–phelloderm; *px.*–primary xylem bundles; *p.ph.*–primary phlœm bundles; *sx.*–secondary xylem; *s.ph.*–secondary phlœm; *pr.*–parenchymatous ray cells gradually widening towards the cortex; *xp.*–groups of xylem parenchyma; *r.*–ray cells separating the vascular bundles from one another; *sg.*–starch grains in the parenchymatous cells; *rc.*–resin canals inside the phelloderm; (Photomicrograph. Eye-piece 5 × and objective 16 mm.)

F

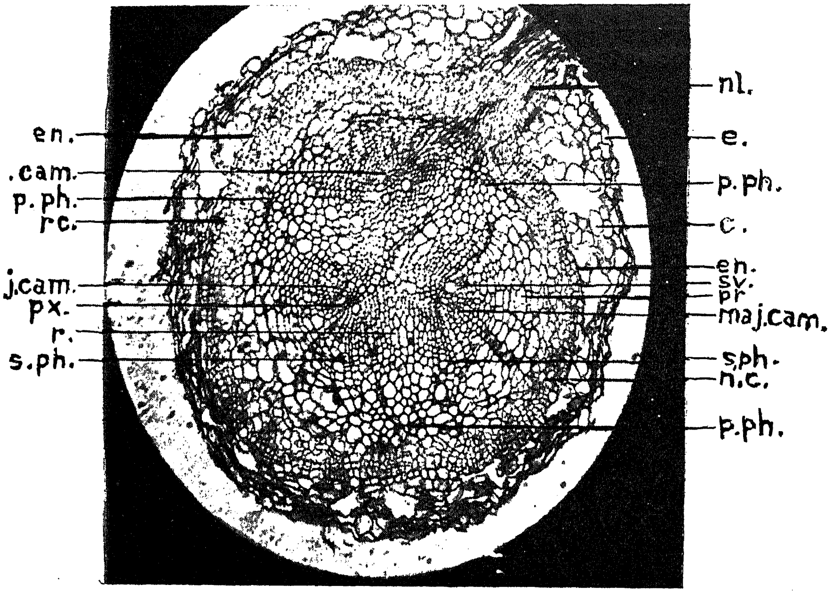

FIG. 2

Transverse section of another root of *Hydrocotyle asiatica* L. with triarch vascular bundles and cambium broken up into 2 arcs

e.–epidermis; *c.*–loosely arranged cortical cells; *en.*–endodermis; *px.*–primary xylem bundles; *p.ph.*–primary phlœm bundles; *pr.*–parenchymatous ray cells gradually widening towards the cortex; *sv.*–secondary xylem vessels—youngest ones not yet lignified; *s.ph.*–secondary phlœm; *r.*–ray cells separating the vascular bundles from one another; *maj. cam.*–major arc of cambium enclosing two xylem bundles; *min. cam.*–minor arc of cambium enclosing one xylem bundle.; *rl.*–production of a rootlet; *rc.*–resin canals (Photomicrograph. Eye-piece 7·5 × and objective 16 mm.)

an approximately radial course and also penetrate between the groups of wood in the direction of the pith. When the axis has attained a thickness of 5–6 mm., meristematic tissue commences to develop in the region of the xylem-mass, *viz.*, along the radial clefts and on the inner side of xylem-segments; this meristematic tissue gives rise to a parenchyma, which undergoes dilatation. The appearance of secondary meristems forming wood and bast in this parenchyma and their junction with the normal cambium of the vascular bundles then leads to the development of a kind of polystely; in consequence of further cleavage, however, this structure soon becomes disturbed, and gives way to a maze of separate segments of wood and bast irregularly interwoven with one another. The ancmalous root-structure of *Oenanthe*, *Magydaris* and *Myrrhis*, etc., of the same family (Umbelliferæ) is of a quite different nature. In summarising cleavage of the xylem-mass in stems in general and also sometimes in roots, Solereder[1] remarks that the ring of wood commences to split up into a number of separate strands by a process of dilatation, *i.e.*, cell division in the parenchyma of the woods, in the pith and the medullary rays. Subsequently, meristems, which produce wood and bast are frequently developed in connection with these strands. According to Solereder[1] a cleft xylem-mass is found in some plants of (1) Caryophyllaceæ, (2) Malpighiaceæ, (2) Sapindaceæ, (4) Cæsalpinieæ (Bauhinia, stem and root), (5) Umbelliferæ, (6) Asclepiadeæ, (7) Convolvulaceæ, (8) Bignoniaceæ, (9) Acanthaceæ, and (10) Aristolochiaceæ.

Dastur and Kapadia[4] have noted the fission of xylem caused by the dilatation-parenchyma in the aerial and the underground roots of *Tinospora cordifolia* Miers. (Fam. Menispermaceæ). Recently, P. C. Joshi[5] has found the stele of old stems and roots of *Thylacospermum rupifragum* Schrenk, a Tibetan Caryophyllaceous plant, splits up into numerous irregular vascular strands in a manner similar to that found in some tropical lianes and in some fleshy roots described by De Bary,[6] Haberlandt[7] and others. He also cites somewhat similar anomaly in the root of another Tibetan plant, *Stellera chamæjasme* Linn. of the family Thymelæaceæ worked out by A. C. Joshi.[8] P. C. Joshi,[5] however, could not find deposit of food substances in any part of the stem and root; but, as I have mentioned before, abundant starch grains are

present in medullary rays and secondary cortex of my specimen (Fig. 1).

In conclusion, I wish to express my gratitude to Dr. S. R. Bose, Professor of Botany of this College, for his valuable help and favourable criticism.

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Carmichael Medical College,
Calcutta,
March 20, 1940.

[1] Solereder, H., *Systematic Anatomy of the Dicotyledons* (Eng. Trans.), Oxford, 1908.

[2] Koch, L., *Entwickl. d. Crass., Verh. naturhist. med. Ver. zu Heidelberg*, 1874, 1 Heft.

[3] Ternetz, Ch., *Bot. Zeit.*, 1902, 60 : 1–20 and Tab. 1.

[4] Dastur, R. H., and Kapadia, G. A., *J. Ind. Bot. Soc.*, 1931, 10, 110.

[5] John, P. C., *Proc. Ind. Acad. Sci.*, 1936, 4, 52.

[6] De Bary, A., *Comparative Anatomy of the Phanerogams and Ferns* (Eng. Trans.), Oxford, 1884.

[7] Haberlandt, G., *Physiological Plant Anatomy* (Eng. Trans.), London 1914.

[8] Joshi, A. C., *Proc. Ind. Acad. Sci.*, 1935, 2, 424.

Vernalisation of Indian Crops

Extensive investigations were carried out for the last two years to vernalise (accelerate the flowering date) through the Russian method of pre-sowing cold treatment of the seeds of some of the economic crops, *viz.*, wheat, barley, oat, gram, pea and cicer. The seeds were soaked in water for four to five hours and after rinsing out the superfluous water, the swollen seeds were placed inside a refrigerator set at a temperature ranging from 6° C. to 8° C. and kept for different periods, 7, 14 and 21 days. In the latter period the coleoptiles protruded from 3 mm. to 5 mm. in length. In none of the experimental crops under the different periods of treatment any significant shortening of the flowering time could be observed. The experiments were repeated in more than one season. The non-response of the tropical crops to this method of pre-treatment as compared to the favourable response of the temperate crops to the latter may be attributed to (1) the qualitative difference between the phasic development of the temperate crops with their lower temperature (thermal stage) and long day conditions (photostage), and the tropical crops with their warmer thermostage and photostage of short day conditions; (2) the effect if any, of the pre-sowing thermal treatment and its possible dependence on the subsequent periods of photostage according to the long or short day conditions, in which the plant has to grow; (3) the probability that the combination of pre-sowing cold treatment and long day conditions as is the case in the temperate climates is only effective, while short day conditions may tend to retard it. This fact seems more evident when actually the cold treatment fails to bring any significant response in the tropical crops.

Therefore the problem of vernalisation of Indian crops presents itself for further investigations under the following aspects: (1) Effect of pre-sowing treatment alone; (2) supplementing the pre-sowing treatment with further post-sowing photostages; (3) is it possible to give the post-sowing photostages as a pre-sowing treatment? Accordingly a scheme as shown in Table I was worked out in case of wheat Pusa var. 165.

From the above set of experiments some very interesting results were obtained. In Experiments 1 and 2 no earliness in the ear emergence was observed either in cold or in warm pre-sowing treatments; but a marked earliness sets in as a result of supplemented post-photoperiodic treatments, being 6·0 days for 24 hours and 12 hours periods and no earliness for 6 hours period. In all the post-sowing photoperiodic treatments in Experiments 1 and 2 the control set behaves similarly as the treated ones, *i.e.*, the same degree of earliness is seen as a result of the post-sowing photoperiodic treatment irrespective of whether the seeds were vernalised or not vernalised at all. In Experiments 3, 4 and 5 thermal factor as supplemented by photo factor as a pre-sowing treatment brings in an earliness of 3·0 days from that of the control; but by a further dose of post-sowing photoperiodic treatment a marked earliness of 15·0 days sets in, in 24 hours

TABLE I

No. of Expts.	Pre-sowing treatments			Post-sowing treatments*				
	Thermal factor	Photo-factor	Duration of treatment	Control	Photo-periods			Duration of treatment
					1 set	2 set	3 set	
			days		hrs.	hrs.	hrs.	days
1	Cold 6°–8° C. ..	Darkness	9	Normal day and night temperature and photo-periods	6	12	24	10
2	Warm 20°–22° C. ..	do.	9	do.	do.	do.	do.	do.
3	Cold 6°–8° C. (9 days) ..	24 hrs. from a 200 watt lamp at a distance of 1 ft. (9 days)	9 + 9	do.	do.	do.	do.	do.
4	Warm 20°–22° C. ..	do.	9 + 9	do.	6	12	24	10
5	..	do.	9	do.	do.	do.	do.	do.
6	*Control*.—Seeds soaked for 4 to 5 hours and sown simultaneously with the treated ones →			Given the same photo-periods				

* Seeds were treated to different photo-periods for the duration of the first ten days from the date of sprouting and then allowed to grow under normal day and night conditions.

light period and 7·0 days in 12 hours light period. This is very significant and indicates the tendency of the earliness to appear when the applied dose of photo factor is greater.

The important results may be summarised in Table II.

The results tabulated under 1, 2, 3 and 4, show the influence of the photo factor in pre- and post-sowing stages in inducing earliness of flowering. From (1) and (3) we find that a pre-sowing photo-treatment hastens the earliness of flowering by three days only, while from (2) and (4) we find that a similar pre-sowing treatment on plants which are further subjected to post-sowing photo-treatment increases the earliness of flowering from 6 to 15 days.

From the above it seems that in tropical wheat the second phase of photostage brings in a complication which tends to retard the process of vernalisation by pre-sowing cold treatment which is found to be successful with the temperate wheat. Investigations to further

TABLE II

No.	Treatments	Mean ear emergence from the date of sowing		Earliness in days
		Treated	Control	
		days	days	
1	Vernalised in cold or warm and allowed to grow under normal day and night conditions ..	54	54	Nil
2	Vernalised in warm or cold and allowed to grow under the photo-periods of			
	6 hours ..	54	54	Nil
	12 ,, ..	48	54	6·0
	24 ,, ..	48	54	6·0
3	Vernalised in light and allowed to grow under normal day and night conditions ..	52	55	3·0
4	Vernalised in light and allowed to grow under the photo-periods of			
	12 hours ..	48	55	7·0
	24 ,, ..	40	55	15·0

elucidate the above facts and to find out the nature of the phase development of the tropical plants are in progress in this Institute and some of the valuable results so far obtained are in course of publication.

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Calcutta,
March 12, 1940.

Volant Animals which act as Carriers of San Jose' Scale

THE San Jose' Scale [*Quadraspidiotus* (*Aspidiotus*) *perniciosus* Comst.] is a destructive pest of deciduous fruit trees. It is commonly distributed through nursery stock. Once it is established in a locality it gets distributed, among other means, by those flying animals which visit an infested fruit tree either to feed, or for shelter and rest as well. World literature dealing with the spread of this pest was consulted and it was found that the information concerning the species of volant animals which act as carriers of its nymphs was extremely meagre. Therefore, it was decided to find out the species of these volants in N.W. India and the work was carried out in the autumn of 1939 in the Kulu Valley.

For the purpose of this study birds and bats were shot from the infested and uninfested orchards as well as from the infested and uninfested plants in the jungle and solitary plants in the fields. During the period that this work was in progress 266 birds and bats were killed and this number comprised 26 species of birds and one species of bats. As soon as the shot animal dropped to the ground it was picked up, placed on a white paper and its legs examined for nymphs very carefully with a hand lens. It was then fumigated and shaken, and the nymphs that dropped off its body were collected for their identification in the laboratory.

The nymphs of San Jose' Scale were found on the following six (1–6) species of Passerine birds and on a (7) bat:

1. The Yellow-billed Magpie: "Chhanchhla" or "Tying-jogring" (*Urocissa flavirostris flavirostris* Blyth.: Corvidæ).
2. The Indian Jungle Crow: "Dhal Kawa" or "Jangli kawa" (*Corvus macrorhynchus levaillanti* Less.: Corvidæ).
3. The Common Indian House Crow: "Kawa" (*Corvus splendens splendens* Vieill.: Corvidæ).
4. The Common Myna: "Desi-maina" (*Acridotheres tristis tristis* Linn.: Sturnidæ).
5. The Simla Streaked Laughing-Thrush: (*Trochalopterum lineatum griseicentior* Hartert: Timaliidæ).
6. The White-cheeked Bulbul: "Painju" (*Molpastes leucogenys* Gray: *Pycnonotidæ*).
7. The Flying Fox: "Barbagal" or "Badur" (*Pteropus giganteus giganteus* Brun.: Pteropodidæ).

Out of these, the first four species (1–4) of birds and the bat (7) are very commonly met with in the valley while the last two species of birds (5–6) are comparatively rare.

We are grateful to the Punjab Government for their very kindly granting exemption from all provisions of Section 7 of the Punjab Wild Birds and Wild Animals Protection Act (in the Kulu Valley) and to the Curator, Bombay Natural History Society, for his confirming our identification of Nos. 1–4 and for identifying Nos. 5–7.

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April 30, 1940.

Detection of Adulteration in "Ghee" (*Clarified Butter*) by the Fluorescence Technique

IN the March issue of *Current Science*, a note[1] was published suggesting a new method for the detection of adulteration in ghee. The authors of this note do not seem to be aware of the work of J. B. Jha,[2] which they have confirmed and which appeared some seven months back in one of the well-known scientific journals of this country.

The two studies, referred to above, were confined to fresh samples. It is well known that ghee when left to age under commercial conditions undergoes putrefactive changes and the resulting product is very different. It would be of interest to study the behaviour of the old ghees in the ultra-violet light.

While it cannot pretend to replace the accepted quantitative chemical methods, now in use, the method deserves careful trial as it appears to be both simple and informative. It is, however, difficult to see how such a costly equipment can find favour with the analysts.

G. NARASIMHAMURTY.

Municipal Laboratories,
C. & M. Station, Bangalore,
May 1, 1940.

[1] Muthanna, M. C., and Mukerji, B., *Curr. Sci.*, 1940, **9**, 120.

[2] Jha, J. B., *J. Ind. Chem. Soc., Ind. and News Edn.*, 1939, **2**, 159.

WE take this opportunity of thanking Mr. Narasimhamurty for drawing our attention to the article of Mr. J. B. Jha. It is a pity that this contribution was missed by us in spite of the fact that one of us (B.M.) is a member of the Board of Editorial Correspondence of the *Journal of the Indian Chemical Society*. However, a subsequent perusal of Mr. Jha's article appears to indicate that he covered only a part of the ground which we had hoped to study. Mr. Jha undoubtedly had the idea of testing the purity of 'ghee' by ultra-violet fluorescence analysis, but he made no attempt to give his method the 'quantitative touch' necessary to measure accurately the amount of adulterant present in a particular sample. We found that by the fluorescence technique (employing the naked eye), it was extremely difficult, nay almost impossible, to detect 20 per cent. or less of adulteration in 'ghee'. Hence we found it necessary to employ a device (Pulfrich photometer and filtered ultra-violet light) by which the intensity of fluorescence emitted could be actually measured in terms of some numerical unit and standard curves drawn for the more common adulterants. An accurate estimate of the percentage of an adulterant present can only be determined by a reference to these standard curves.

Mr. Narasimhamurty has brought out an interesting point with regard to the ageing of 'ghee' and the response of such 'ghee' to ultra-violet fluorescence. This is an important question and is already receiving our attention though our work in this direction has not yet progressed to a stage to make a pronouncement on the subject possible.

We fully realise that this method of fluorescence analysis is not perfected to such an extent as to replace the existing methods universally employed for 'ghee' analysis, but we feel that it holds out possibilities and deserves further and more extensive trials by the analysts. With regard to the question of cost, Mr. Narasimhamurty has not apparently taken into account the fact that the outlay for a Pulfrich photometer assembly, although fairly expensive, is only an initial outlay and does not involve a recurring expenditure of any magnitude. Further such an equipment will come to the service of analysts in more than one sphere, *e.g.*, detection of adulteration in vinegar, spices, eggs, drugs, etc. It is yet too premature to foresee the utility of such an assembly in an analytical laboratory.

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Calcutta,
May 13, 1940.

REVIEWS

The Mathematical Theory of Huygens' Principle. By B. B. Baker and E. T. Copson. (Clarendon Press, Oxford), 1939. Pp. 135. Price 12*sh.* 6*d.*

The book is a monograph which deals with the Mathematical Theory of Huygens' Principle and discusses the general theory of the solution of the partial differential equations which govern the propagation of light. Some simple diffraction problems which serve as illustrations have also been discussed.

The book is divided into four chapters. In the first chapter, the scalar form of Huygens' principle, as applied to the propagation of sound waves has been considered. The validity of the application of Huygens' principle in Optics has also been discussed. In this connection it may be mentioned that a light wave is specified by the three components of the "Light Vector" whereas a sound wave is characterised by a single quantity. Wave motions in two and three dimensions have been considered. Hadamard's "Method of descent", *i.e.*, the mode of finding two-dimensional cylindrical wave-functions by applying the method of determining three-dimensional wave-functions under certain conditions has also been explained. The solutions of the equation of cylindrical waves as given by Weber, Volterra and Marcel Riesz have also been discussed.

In the theories of Volterra and Hadamard, there are certain awkward limiting processes which Riesz avoided in his elegant method by introducing an arbitrary complex parameter α and by applying the theory of analytical continuation of a function of a complex variable. There is a great disadvantage in Hadamard's method. He did not avoid the occurrence of divergent integrals but devised a method of picking out "finite parts" of such integrals. But the method of picking out the finite part of a divergent integral can only be applied to a space having an even number of dimensions. In the space of an odd number of dimensions Hadamard's method does not apply. It is an established fact that diffusion of wave-motion always occurs in space of an even number of dimensions whereas in a space of odd number of dimensions it may or may not occur. The solution obtained by Riesz's method is independent of the number of spatial dimensions and so it has got a great advantage over other methods.

In the second chapter, Kirchoff's and Kottler's theories of diffraction by a black screen have been discussed. Kirchoff obtained his formula for diffraction on the assumption of certain boundary conditions which have been found to be incompatible with each other. In spite of this difficulty the above formula gives results which agree remarkably well with experiments. Many authors regard this formula as a fairly accurate first approximation; on the other hand Kottler and other authors think that Kirchoff's formula is an accurate solution of a "*saltus problem*", and it is not to be taken as a boundary value problem. By giving a different definition of blackness, Kottler deduces the formula quite rigorously. As a satisfactory physical definition of a thin black screen is not possible, Kottler gives an analytical definition of blackness for such a screen.

In the third chapter, analytical formulation of Huygens' principle for electromagnetic waves has been developed. It is shewn that the formula of Kirchoff and of Larmor and Tedone for diffraction are equivalent so far as both "express the components of electric and magnetic vectors as integrals over a closed surface; the two formulæ differ by a quantity which vanishes in virtue of Green's theorem". But these formulæ are inadequate as neither of them when applied to the components of an electro-magnetic field having an open surface of integration leads to the solution of Maxwell's equations.

It may be mentioned that Kottler's definition of "black screen" is quite satisfactory as no energy is reflected from such a screen.

In the fourth chapter, Sommerfeld's theory of diffraction has been fully discussed. Sommerfeld has successfully used many valued solutions of Maxwell's equations to problems of diffraction of light caused by a perfectly reflecting half plane or wedge. Sommerfeld has introduced the idea of "Reimann Space" into diffraction problems. The treatment is analogous to similar two-dimensional problems in electrostatics. When many valued solutions of

Maxwell's equations in ordinary three-dimensional space get transformed in a "Riemann Space", they become single-valued functions of position in the latter (Riemann) Space. This "Riemann Space" is quite different from "Riemannian Space" considered in modern differential geometry.

An ideal black screen cannot be attained experimentally, nor precisely defined in electromagnetic theory. Ignatowsky has rightly observed that as it is not possible to have any general definition of black screen which is applicable to every case, each diffraction problem relating to such a screen must be discussed separately on its own merit. The theory of diffraction by a perfectly reflecting screen as worked out by Sommerfeld may be accepted as quite a satisfactory one.

The printing and get-up of the book are excellent and it may serve as quite a good text-book for those who want to make a specialised study of Huygens' principle. The number of diffraction problems that have been discussed is rather restricted. The usefulness of the book would have been greater and it would have served better as a standard book of reference if a more complete account of different methods of solving special diffraction problems were given. A judicious choice of additional problems illustrative of technical developments of the theory of diffraction would make the monograph complete in itself without unduly increasing its size.

A. C. BANERJI.

Advanced Algebra. By S. Bernard and J. M. Child. (Macmillan & Co., London), 1939. Pp. x + 280. Price 16*sh*.

This book is the promised continuation of the same authors' *Higher Algebra* which appeared sometime ago. It contains chapters on quadratic residues, primitive roots, sums of two or more squares, indeterminate equations of the second degree, continued fractions and invariants. Several chapters are devoted to topics not strictly algebraic —double series, uniform convergence, complex variables, life contingencies, etc. A large number of examples are provided and a collection of miscellaneous examples is placed at the end of the book.

It must be confessed that on the whole the book is a little disappointing. One misses the true algebraic spirit in a book which professes to be an introduction to *Advanced Algebra*. We look, in vain, for even a mention of the important concepts of ring, group, field, ideal, etc.,—concepts which have raised Algebra to a ruling position in modern mathematics. Considering the very important part played by modern algebra both in pure mathematics and in mathematical physics, one would naturally have expected to find an elementary exposition of abstract algebra—an exposition, say, which would serve as an introduction to the beautiful texts by van der Waerden and Albert. The desirability of introducing the student early to the concepts and methods of abstract algebra has been affirmed repeatedly,* and Weyl's dictum† that "a knowledge of them should be as widely disseminated as the elements of the differential calculus" applies to-day with even greater force. Quite a good deal of space is devoted to a discussion of double series, uniform convergence and other topics of analysis; surely this is unnecessary in a text-book on Advanced Algebra at the present time, when nearly every week brings forth new Text-books of Convergence and Introductions to Analysis!

These remarks must be understood to refer to the general plan of the book and the total impression created by it, and not to the treatment of the individual topics in the various chapters. Perhaps the book might meet the needs of students who have in view the exigencies of certain examinations and whose main interests are otherwise than algebraic. But it is of little help to those who are interested in modern Algebra either for its own sake or on account of its manifold applications.

V. R. THIRUVENKATACHAR.

* For a recent statement, see *Amer. Math. Monthly*, 1939, **46**, 635–42 and *Math. Gaz.*, 1940, **24**, 15.

† Weyl, *The Theory of Groups and Quantum Mechanics*, p. xxii.

Astronomy. By William T. Skilling and Robert S. Richardson. (Chapman & Hall, Ltd., London), 1939. Pp. 579. Price 15*sh*.

The aim of the authors in preparing this attractive book seems to be to provide a suitable text-book that can be used by students taking a first (or elementary) course in astronomy in college classes. It deals mostly with the descriptive parts of the science without entering into the technical or mathematical details. A glance through the pages will be sufficient to show that the book possesses certain distinctive

characteristics not found in the general range of text-books available in the subject. The order and style of presentation appear to be excellent and the language is as far as possible, simple and non-technical, so that the book may meet the requirements of the intelligent layman as well, who desires to have a concise account of the main facts of descriptive astronomy. Considerable care has been exercised in the choice of material and emphasis has been laid on those topics which according to the authors "should become common knowledge to all educated people".

The earth, as the abode of the observer, is treated in the first chapter, and in the second, there is a clear explanation of the various systems of co-ordinates employed by astronomers for locating heavenly bodies on the celestial sphere. It is noteworthy that the idea of galactic co-ordinates, which plays such an important part in studies of stellar dynamics, is introduced so early in the course. Chapter III contains a description of the general equipment of a modern observatory and the uses of the several instruments. There are sections dealing briefly with astronomical photography and spectroscopy; mention may be made of the concise description of the Schmidt Camera and the blink comparator, the use of which has come into prominence during recent years. The next two chapters are devoted to the study of the sun—the star nearest to the earth—which is treated in all its details. Chapters VI to VIII deal respectively with Time and the Calendar, the Moon, and Eclipses, where at the end, is included an account of an interesting eclipse expedition. We have next an excellent chapter on the "Tides, their nature and causes". The solar system as a whole is treated in Chapter X which is followed by chapters on Planets described individually, Comets and Meteors.

The main facts of sidereal astronomy are presented in the two succeeding chapters where we find a succinct account of the methods of determination of stellar parallaxes, the motions of stars and their arrangement in space as well as the phenomenon of galactic rotation, recently discovered by Plaskett and Oort. Chapter XVI entitled "Differences among stars" deals with a variety of topics such as brightness of stars, apparent and absolute magnitudes, the size of stars, stellar spectra, giant and dwarf stars, and the general problem of variable stars. The treatment is fairly elementary, and the principal results have been clearly summarized. Nebulæ—galactic and extra galactic—form the subject-matter of the last chapter which gives a complete survey of our present knowledge of these interesting objects and their place in the Universe. The glossary at the end of the book will be found specially useful, by the beginner in mastering the technical terms.

The problems and exercises given at the end of each chapter will be of great help to the student preparing for university examinations. The illustrations are good and have been carefully selected; and the get-up, on the whole, is excellent. The book may be confidently recommended to the student taking a first course in the subject, as well as to the general reader who requires a concise and up-to-date account of the various topics of descriptive astronomy.

T. P. B.

College Course of Inorganic Chemistry. By Partington. (Macmillan & Company, London), 1939. Pp. x + 658. Price *8sh. 6d.*

This is a very good text-book of Inorganic Chemistry for students of the Intermediate Science courses of the Indian Universities, although it goes even beyond their requirements. As the author himself admits, this is in many respects an abridgment of the author's larger text-book of Inorganic Chemistry for University students, meeting just the needs of the beginners. The book commences with the general principles of Chemistry and then deals with the chemistry of the common elements like oxygen, hydrogen and the halogens. Then a few chapters on Physical Chemistry are written giving elementary ideas on electrolytic dissociation, molecular weights, chemical equilibrium and law of mass action. The subsequent chapter deals with the periodic law and atomic structure wherein elementary ideas on the modern concepts of valency have also been clearly given. Thereafter the chemistry of important elements is described in the order of the groups in the periodic table. The historical approach which really introduces an element of interest and reality has often been used. This book will thus be of very great use for the Intermediate students.

M. Seshaiyengar.

Laboratory Methods of Biochemistry. By A. Bertho and W. Grassmann, translated by W. McCartney. (Macmillan & Co., Ltd., London), 1938. Pp. xiv + 281. Price 8*sh.*

In a rapidly expanding field of science like modern biochemistry, it is difficult to bring out a volume on practical biochemistry, which will remain unsuperseded in a short interval of time. Improvements in the technique of preparation and measurement are being continuously introduced in this field.

The present volume serves as a useful and intensely practical volume for the young biochemist who is to be initiated into the subject. This is a companion volume to Gattermann and Wieland's Laboratory methods in organic chemistry. Biochemistry is not taught in many of the Indian universities and in a few others, adequate attention is not paid to this subject. We have no doubt that this defect will soon be remedied. The appearance of this handy volume will be welcomed by all the universities who wish to encourage the study of biochemistry.

M. S.

Modern Inorganic Chemistry in Tamil —Part I. By N. Anantavaidhyanathan. (Annamalai University, Annamalainagar), 1938. Pp. xxx + 1264. Price Rs. 3.

This book on Chemistry is a pioneer attempt in Tamil. Many of its 36 chapters make very interesting reading. The chapter on periodic classification is particularly well written. Advanced matter, not intended for the students of the Intermediate classes, is printed in small type. There are 171 clear-cut diagrams and 13 photogravures. The format is good. This excellent but bulky book is priced at only Three Rupees. It is hoped that the second part of this book will contain the necessary index, without which even good books become difficult to use. The talented author and the Annamalai University are to be heartily congratulated for producing and publishing a book of this kind and the reputation of the University will be enhanced if it can make arrangements to use its own publications in its University Classes.

An intolerable situation has arisen in Tamil with regard to Chemical nomenclature and terminology. Departmental Committees, set up ten years ago to find out or coin Tamil equivalents of Scientific terms, took the index of standard science books and, coined, according to their intuition, intelligence and experience, a set of Tamil equivalents, often derived from Sanskrit roots and occasionally selected from Tamil usage, and they were duly published by the Government. Authors, who wrote text-books in Tamil for use in the High School classes, used these Tamil equivalents, good, bad or indifferent, in their books since they thought that by a religious adherence to 'approved' terms, their books would be readily and easily recognised by the Text-book Committees. And Sri. Anantavaidhyanathan has also adopted a similar procedure in his book. The result is an unpleasant jargon rich with hard, disagreeable and fantastic words and phrases in a Tamil garb. The method followed by the authors of the Text-Book in Chemistry in Urdu published by the Osmania University, Hyderabad, is different. They have rightly transliterated the English terms without endeavouring to coin Urdu equivalents for the chemical terms used in their book. The reviewer feels strongly that the latter system would have been appropriate, less cumbersome, and more elegant and easier to follow in Tamil also. Any living language must enrich itself with words from trade and commerce, science and invention and war, and the Tamil language, if it should grow, must do so now and in the future as it did in the past. It is a relief to find that the author has not coined Tamil words for petrol, benzene, gram, litre, litmus and other words. He would have done well to have adhered to his dictum elaborated on page xiii of his book.

Within the limits of our space only a few instances of the errors of omission and commission found scattered in the pages of the book may be noticed. The author has used the English symbols for the Tamil names of elements, and equations are also given in English to represent chemical reactions! A uniform method must be followed. In a standard text-book on Inorganic chemistry such interjections, expletives and philosophisings as are found on pages 52, 834, 1207 and other pages may well be omitted. The size of the book could well be reduced by omitting the many biographical and historical details and also the extracts from Sanskrit and Tamil literature like those found on pages 44, 47, 308 and 738. Descriptions of obsolete manufacturing processes as on pages 113, 114 and 404 can also be omitted,

Some statements require correction; *e.g.*, "When Mercuric Oxide is heated in a test tube, mercury is found in the bottom of the test tube" (p. 86). The list of elements on pages 76–80 gives the reader an impression that there are 96 known elements. One reads on page 103 that the substance which sustains all animate beings is a *mixture* of carbon, hydrogen, oxygen and nitrogen, and on page 135, that, by passing an electric current through *water*, the process of electrolysis can take place! There is no use copying the physical constants as given in the English books written for Latitude of about 45°. Solubility data should be given upto 30° C. for the average Tamil Nad environment and not stop at 20° C. as in English books (see pages 204, 422, 574 and 762). There are four pages of errata in the book, but the list is still incomplete. The whole book requires careful revision in detail; this is perhaps inevitable in a pioneer work and our observations have been directed by a desire to see a good book made better in its next edition which should not be long in coming if the change in the medium of instruction is practical politics, and not a distant ideal in the educational world.

K. C. VEERARAGHAVA AYYAR.

Bibliography on Cold Resistance in Plants. (Imperial Bureau of Plant Breeding and Genetics, Cambridge), 1939. Pp. 22. Price 1*sh.* 6*d.*

The economic importance of cold resistance in plants has long been recognised by growers who know from experience the havoc that may be done to a susceptible crop as the result of a single frosty night. Recently its importance has increasingly drawn the attention of breeders and physiologists, and there is now a considerable literature dealing with the problem of cold resistance. The Imperial Bureau of Plant Breeding and Genetics in issuing this compilation has rendered a service to plant breeders which will be much appreciated. In addition to references to papers on breeding for cold resistance and the genetical aspects of the problem, others of a more general nature bearing on the physiological nature of resistance and on problems of technique are included. The usefulness of the bibliography has been enhanced by the classification of the references under appropriate subheads and by the indication, in the case of papers which have been abstracted by the Bureau, of the relevant Volume and Abstract number in "Plant Breeding Abstracts".

B. P. P.

Field Trials: Their Lay-out and Statistical Analysis. By J. Wishart. (Imperial Bureau of Plant Breeding and Genetics, Cambridge), 1940. Pp. 36. Price 2*sh.* 6*d.*

In this bulletin we have yet another valuable publication from this well-known authority on agricultural statistics and field experimentation, dealing with modern methods of laying out field experiments and their statistical analysis and interpretation.

Stating briefly the necessity for field trials as they are conducted to-day, the author explains in a concise and simple manner what is meant by the experimental error and the test of significance. He then deals with the methods of lay-out, the analysis of the data and their interpretation, involved in the randomised blocks and Latin Square methods. Chapters on multiple factor and split-plot experiments, confounding and the testing of a large number of varieties at a time, introduce the beginner in an easily understandable way to the most recent developments in field experimentation. The notes on calculation in the chapters on randomised blocks and Latin Squares are a useful feature.

The bulletin should prove a great help to those engaged in conducting field experiments of various kinds, in India and elsewhere.

B. P. P.

Hilsa Investigations in Bengal :

(1) "On Some Early Stages in the Development of the so-called Indian Shad, *Hilsa ilisha* (Hamilton)." By K. Krishnan Nair. *Records of the Indian Museum*, 41, Part IV, pp. 409–18 (Calcutta, December 1939). (2) "Further Observations on the Bionomics and Fishery of the Indian Shad, *Hilsa ilisha* (Hamilton), in Bengal Waters." By Sunder Lal Hora and K. K. Nair. *Records of the Indian Museum*, 42, Part I, pp. 35–50 (Calcutta, March 1940).

Mr. Nair's paper is devoted to an account of the early post-larval stages of the Indian Shad or as it is more popularly called, the *Hilsa*. Since this fish is of considerable economic importance it follows that a full knowledge of its development is desirable. The *Hilsa* is an anadromous fish, that is one which ascends from the sea into tidal or fresh waters in order to spawn. Experience in Europe and America tells us

that anadromous fish are particularly liable to suffer from the effects of overfishing. Whether this is now, or is likely to be the case in the near future, to be feared in the case of the *Hilsa* is not yet clear, since reliable statistics are wanting. Should the *Hilsa* be declining as the result of overfishing, there are several remedial measures which might be applied, such as artificial hatching, a close season or regulation of the fishery. But it is obvious before we can discuss measures of control or amelioration we must know about the life-history of the fish. And this is precisely why papers such as this of Mr. Nair are of use and importance. The early post-larval stages of the *Hilsa* are described in some detail and the work has been carried out with strict attention to the most modern methods applied in this class of research. The material was obtained from the Pulta Waterworks, Calcutta, where recently these fry were first discovered by Dr. Hora.

While much of the detail is perhaps of interest to specialists, it must not be forgotten that a fish of great economic value is dealt with, that the methods of investigation are modern and sound, and the results of value. In the opinion of the reviewer this paper reflects credit not only on the author but also on the Zoological Survey of India under whose auspices it is published.

The second paper is a continuation and expansion of the one by Dr. Hora on the spawning grounds and bionomics of the *Hilsa* which was reviewed in *Current Science* in November 1938.

At the outset it may be said that the authors have succeeded in writing a paper which is both important and interesting—a rare combination in a scientific paper. Often an important paper is spoilt by its style and arrangement; on the other hand, many interesting papers are for specialists only.

We have here a complete and up-to-date account of one of the most valuable, if in fact it is not the most valuable, of Indian fish, and moreover a fish whose life-history has until quite recently been a complete mystery. The first important step in the solution of this mystery was the discovery by Dr. Hora of the larvæ of the *Hilsa* at the Pulta Waterworks of the Calcutta Corporation in November 1937, and also at Nawabgunge in the same cold weather.

Following up this discovery Dr. Hora and Mr. Nair were able to clear up many dubious or unknown points in the *Hilsa's* life-history. Previous investigators were led astray through relying too much on the bionomics of anadromous fish in other countries. In Great Britain, Europe and America fish which move up from the sea to tidal or fresh waters (*i.e.*, which are anadromous) do so for the purposes of spawning only and not for feeding as well. Consequently they do not ascend rivers beyond the place of spawning. In 1918 Southwell wrote:—

> "Very large numbers of *Hilsa* have been examined. In every case the stomachs were found to be empty and much contracted. This is a feature which *Hilsa* shares with other anadromous fishes all over the world."

British anadromous fish such as the salmon, sea-trout and smelt spawn in definite and restricted areas; the salmon as far upstream as it can get and the smelt in a narrow and confined area at the head of tidal waters. It was assumed, wrongly as we now know, that the *Hilsa* would have habits somewhat similar to these British anadromous fishes, but it is now conclusively clear, through the researches of Dr. Hora and Mr. Nair, that the *Hilsa* can and does spawn at widely different places in the Ganges and Brahmaputra watersheds, from the tidal waters upwards. This paper must be read to be appreciated. The bald summary here can hardly do it justice.

In the first place the investigations at the Pulta Waterworks are described, together with the breeding season and rate of growth of the larval stages. To supplement the Pulta researches collections were made at various points in the Hooghly and other waters at various seasons of the year; and young stages were sought in the markets. It is found that the *Hilsa* breeds in the river throughout the year, the peak period being in July–August and a second lower peak in May. These peak periods correspond with the flooding of the river owing to the monsoon and the nor'westers.

The rate of growth of the *Hilsa* is rapid, fish from ten months to a year old are about one foot in length.

To supplement the information collected locally, collections were made in East Bengal by Mr. Datta who was successful in obtaining young *Hilsa* in the river at Gazalia and Galachipa and in the markets at Patuakhali

and Narayangunge. Examination of the adult specimens shows that the *Hilsa* probably breeds at Patuakhali in February, as it does in the Hooghly river. The presence of mature males at Chandpur in February points to the same conclusion.

The authors then deal in some detail with the up-river migration of the *Hilsa* obviously a point of considerable value to the fisheries. They claim, and we think with justice, "our investigations have definitely established that migration is for spawning purposes", but they are careful to add that still more research is needed to fill up gaps in the narrative.

Another section of the paper deals with the *Hilsa* fishery in Bengal and there are interesting comments and reflections on the fluctuations of the fishery. Like all fisheries, that for the *Hilsa* is subject to annual and seasonal variations. An interesting theory put forward is that there is a five-year cycle in the fishery, but unfortunately the statistics of the fishery are not sufficiently extensive or detailed to prove or disprove this theory.

Another question is: Are there two or more races of *Hilsa*? Are the fish which spawn in the Sunderbans and those which spawn up the Ganges beyond Monghyr distinct races, and if so, can these races be distinguished apart; as the races of herring (which like the *Hilsa* is a Clupeoid fish) are in Europe?

The reviewer thinks that in some cases too much has been made of the racial differentiation of one single species of fish such as the herring, but on the other hand it is a question well worthwhile investigating in the case of the *Hilsa*. The *Hilsa* sent to the Indian Museum by Prof. Bhattacharya from Allahabad were remarkable as they were marked with black spots, a characteristic feature of the young. It is impossible to give a complete resume; the value and utility of the paper can only be properly realised by or through a personal perusal. With a fish of such handsome appearance and delicious taste one does not need to be a zoologist to learn about its bionomics and life-history; and Dr. Hora and Mr. Nair are to be warmly congratulated not only on having such a valuable subject to investigate but also with the skill and ability with which they have carried out the work.

J. T. J.

One Day Telleth Another. By Stephen A. Ionides and Margaret L. Ionides. (Edward Arnold & Co.), 1939. Pp. 324. Price 10*sh*. 6*d*. net.

When Socrates proposed to Glaucon to make Astronomy their next study, Glaucon agreed, for a working knowledge of the seasons, months and years is beneficial to everyone, to commanders as well as to farmers and sailors. Thereupon answered Socrates: "You make me smile Glaucon. You are so afraid that the public will accuse you of recommending unprofitable studies."

And indeed Astronomy is not an unprofitable study. But is it of much profit as set out in this intriguing book? Can we call it Astronomy? Hardly. Or the history of Astronomy? Scarcely. Or the romance of Astronomy? Perhaps. What is certain is that it is a book written by leisured people for people of leisure. Are any such in India? (leaving aside, of course, Rajahs and Princes, whose multifarious occupations will leave no time to enter the by-ways of astronomical lore). We doubt it. Hence, while we wish the book good luck in the country of its birth, we do not feel justified to recommend it to Indians.

D. F., S.J.

A Short History of Science. By F. Sherwood Taylor. (The Scientific Book Club, London), 1940. Pp. xiv + 320, 14 plates and 36 figures. Price 3*sh*. for members.

At a time when passions run high, nationalism becomes narrow and selfish interest renders people blind to the common good of mankind, a history of science is a particularly useful publication. Whatever differences there may be in the type of problem that interests people of different races or regions, there can be no doubt that the discovery of truth is the object of science and its method such that no one should have any scruples in giving assent to its findings. Science is also universal in the sense that it is not the creation or the exclusive preserve of any one nation. Different peoples have, at different times, contributed to its development. Although the nature and the extent of this contribution have varied with the genius and the predilection of various peoples, it is a fact that all civilised nations have contributed and are contributing to its growth. The book before us gives us a clear picture of this cosmopolitan character of

science and shows how the efforts of various peoples have brought it into being and are helping in its growth. It also shows how there were no separate divisions in early science, and, how even now, when its complexity makes specialization inevitable, the application of the methods and results of one branch leads to new developments in another. The book ends with a note of doubt as to whether the regularity of its picture of the world is not merely due to the method it adopts, and also as to its applicability to the non-material part of our experience. However, a perusal of the book is a good remedy for any tendency towards a prejudiced and narrow outlook on life and we must congratulate the *Scientific Book Club* on making such a lively book available to the general reader at such a low price. A number of quaint illustrations and extracts from ancient books adds to the peculiar charm of Dr. Taylor's treatment which we have learnt to admire in his *"World of Science"*. We wish that everyone should read this history of science and ponder over its lessons. T. S. S.

The Fight for Life. By Paul De Kruif. (The Scientific Book Club, London), 1940. Pp. 320. Price 3*sh.* for members.

This is a fascinating volume which narrates in vivid language the story of man's ceaseless fight for life against the numerous and deadly diseases which challenge the right of man to live. Heavy tolls of life are taken by maladies which need no longer afflict humanity, by diseases whose incidence and spread is due to ignorance, poverty and malnutrition. There are, of course, other diseases like infantile paralysis which afflict humanity irrespective of their social status —the rich and the poor alike.

The scientific investigator, in dealing with diseases resulting from poverty and malnutrition is faced with the problem of not only finding a remedy but also of one which is "dirt cheap", if it should have any practical application. This is the kind of problem with which investigators in India are confronted.

The second part of the volume consisting of four chapters deals with the fight against "maiming death"; this should be read by every scientific investigator; the struggle, still in progress, constitutes one of the most determined and romantic fights against infantile paralysis. The scientific investigator had his moments of defeat and depression; this elusive and mysterious disease has baffled and misled him on several occasions but the fight continues with renewed vigour and energy.

There is a good deal in this volume which will appeal to administrators and philanthropists of this unfortunate and disease-ridden country, which has yet to witness the kind of successful fights against death, waged in Europe and America. We hope that this extremely interesting and low-priced volume will be read by a large circle of men and women in this country. M. S.

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(1) **Guide to the Archaeological Galleries.** By F. H. Gravely and C. Sivaramamurty. (Madras Government Press), 1939. Pp. 48. Price Re. 0–8–0.

(2) **Illustrations of Indian Sculpture.** By F. H. Gravely, and C. Sivaramamurty. (Madras Government Press), 1939. Plates XLV. Price Rs. 1–8–0.

These publications are welcome not only to visitors of the Museum but to students at large. The authors give an introduction to the South Indian Temple, Architecture, Sculpture and Iconography. It is based on archæological tradition which is, on the whole, safe to follow. We are thankful for the introduction of a section on ancient Indic culture. But the 'Mohenjo-Daro civilisation' can no longer be described as 'pre-Aryan'. Nor could evidence be cited for the view that Asoka brought his skilled sculptors from Eurasia. Harappa statuary bespeak an antiquity for stone sculpture in India, and it can no longer be held that 'Buddhists and Jains were the first to develop sculpture in stone'.

The sketch will serve to educate the general reader, and deserves to be translated into Tamil and Telugu for the benefit of the museum-going thousands. The illustrations are well turned out, and the price has been fixed low so as to place these pamphlets within the reach of all.

S. V. V.

PROBABILITY AND FREQUENCY

Probability and Frequency. By Professor H. C. Plummer, M.A., F.R.S. (Macmillan & Co., Ltd.), 1940. Pp. xi + 277. Price 15*sh.*

THE world is rapidly coming to realise the immense role played by "chance" in all matters commercial, social, political or scientific. In other words, "indeterminism" seems to have come to stay as an organic part of our civilisation and culture. Though as Bertrand Russel put it "chance" may be negation of all laws, mathematical acumen has been sharp enough to penetrate beneath the apparent lawlessness or randomness and evolve a working set of rules for our guidance. Theories of Probability are the result of mathematical studies of "chance events". Many text-books on Probability and Statistics have been written with specific applications to economics, business statistics, medicine, biology, and education, in order to cater to the needs of non-mathematicians interested in these fields. They cannot therefore afford to put in sufficient mathematics. Here we have a book by an eminent astronomer boldly coming forward to give the necessary mathematical background to the subject without any fear of persons unsophisticated mathematically. The author is however rather modest in regard to his aim. His ambition is only to provide an introduction to the general ideas of the subject from a simple mathematical point of view, and refers to his work as too "slight" to need a bibliography. Perhaps the consciousness of the author that he is not making a novel contribution has affected the exposition which is very much condensed and not quite easy to follow, explanations in worked examples being of the tabloid form.

The treatment of probability is designedly of the usual text-book variety based on the Laplacian doctrine of exclusive and exhaustive alternatives of equal probability and therefore makes no mention either of modern theories or criticisms of the classical school like those of Richard von Mises, H. Cramer, A. Kolmogoroff or Maurice Frechet. The author believes, in J. M. Keynes' manner, that what he calls Bernoulli's Capital theorem which is deducible from the Laplacian definitions gives a precise meaning to the relative frequency definition originally due to Leslie Ellis (*vide* p. 92, "A Treatise on Probability" by J. M. Keynes) but here attributed to Chrystal. The first two chapters deal with probability and introduce the reader to almost all the simple and noteworthy problems and theorems due to Huyghens, Montmort, Tschebyscheff, Bernoulli, Bertrand, Burnside, Poincare, Crofton, Buffon, and others. They contain also some incidental and necessary pure mathematics, Stirling's approximation to factorial n, Euler's Gamma and Beta functions, and Dirichlet's integral. The introduction to *a posteriori* probability and the theorem of Bayes is remarkably clear and leads on to a suggestion of a sort of fiducial probability, the range to be attributed to the probability to be inferred when the frequency is given. The discussion is enlivened by such humorous touches as the following:

> "Not even the most primitive mind contemplates a Twilight of the Gods, when the sun will rise on week-days only; it is doubtful if the Eskimo thinks of the play of chance when the sun remains above or below the horizon."

In support of the urgency of Bayes' rule, it is asserted that any justification must be found in the absence of any alternative way of grafting a few isolated facts on the tree of ignorance. Every meteorologist knows of occasions when an answer must be found and the best, if not the ideal answer, must be given, provided it shall not violate the established principles of probability (pp. 115 and 116).

It is probably not too much to affirm that nowhere has a student of probability been warned against the misuse or abuse of the ideas of continuous probability in relation to *a posteriori* probability as in para 122 of this book. The real obstacle to the application of the theory lies in the uncertainty regarding the *a priori* probability. When this law of probability is known, the *a posteriori* probability can be calculated in the light of observed facts on principles which are sound enough. The result is a modified law of probability, which virtually represents the probability of a probability or probability at second hand, as it were. As

a measure of frequency this inverse probability or probability of causes must be regarded as inferior to a more direct determination based on fuller knowledge. But only too commonly a knowledge of the *a priori* probability is entirely absent. It is then only possible to make some hypothesis to supply the deficiency. The assumption should be as reasonable as may be, and should at least cover all conceivable possibilities. It may then be fairly hoped that the result will represent a tolerable approximation to the truth.

The third chapter deals with the theory of errors in which the astronomer feels naturally at home. Prof. Plummer does not admit the validity of the deduction of the normal law from the assumption that the errors of observations are the result of unlimited independent sources (p. 132). On the other hand, in such typical cases as the astronomical observations of position, the law represents the errors of a good observer in favourable circumstances. While the law admits the possibility of errors larger than can occur, it tends to underestimate the probability of errors which do occur. However, the astronomer has adopted it on account of the practical advantages it offers. After studying the error functions in some detail, the author proceeds to expound the mathematics of the Method of Least Squares deriving formulæ for the standard deviations of the unknown. A note of warning is sounded that when everything (mathematically) possible has been done, it must not be regarded as surprising when the probable error of a determination is proved to be exceeded several times by the result of a later investigation (p. 166). The mathematical method gives a measure of the self-consistency of the solution rather than that of the true accuracy of the observations. We are told that astronomers' troubles lie in other directions than mathematical, such as inadequacy of the number of observations, choice of appropriate weights to be attached in the combination of observations from different sources and the presence of systematic error (p. 177).

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On the whole, Prof. Plummer's book will appeal greatly to all persons whose mathematical equipment is more or less of the Honours standard of an Indian University. We have no hesitation in recommending it to every mathematical aspirant, student or teacher, who wants to enter into the new discipline which is coming to have an ever-expanding field of applications.

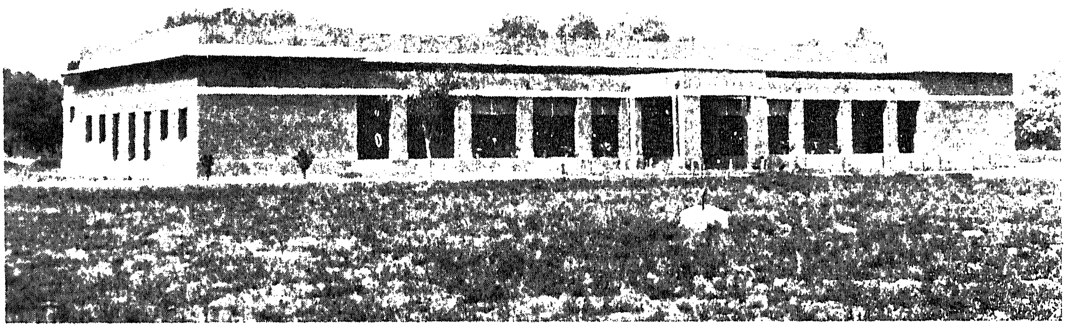
K. B. MADHAVA.

IMPERIAL VETERINARY RESEARCH INSTITUTE

Animal Nutrition and Poultry Research Sections

TWO important additions to the Imperial Veterinary Research Institute have recently been officially opened by His Excellency the Viceroy. These are the Animal Nutrition and Poultry Research Laboratories, erected last year at Izatnagar. The original laboratories of the Imperial Institute are situated at Mukteswar in the Kumaon hills, where, the climatic conditions being considered more suitable than those of the plains for the carrying-out of the finer operations of biological research, the Institute was founded in 1893. Its purpose was then defined as the investigation of the diseases of domesticated animals in India and the preparation of agents for their control. In 1901, land was purchased at Izatnagar near Bareilly to provide for the carrying-out of certain experiments in the winter months. Successful researches at Mukteswar led to the manufacturing for sale of various biological products for the prevention and cure of animal diseases. As the demand for these rapidly increased, it was decided in 1913 to open a section for the production of anti-sera on the Izatnagar site, where more space was available for development than at Mukteswar.

With the gradual establishment of some measure of control over the contagious diseases that had previously proved so great a scourge to animal husbandry, the wider aspects of veterinary work in India became more apparent. Particularly was this the case in regard to the recognition of the necessity for the study of animal nutritional problems. As early as 1923, a Physiological Chemist's Section was opened at the Imperial Institute of Animal Husbandry and Dairying, but, as it was later on felt that more space was necessary for this work and that Bangalore was somewhat isolated from cognate research, it was decided, in 1938, to transfer this section to the Imperial Veterinary Research Institute and to build new laboratories for its accommodation at Izatnagar. At about the same time the Imperial Council of Agricultural Research agreed to give a grant to the Imperial Veterinary Research Institute for the establishment of laboratories to be devoted to research into questions concerning poultry.



Poultry Research Section

The buildings, constructed at a cost of about Rs. 8 lakhs as a result of these decisions, comprise the Animal Nutrition and Poultry Research Sections. The main Animal Nutrition building contains several Physiological laboratories, where various techniques are employed in the study of the physiological effects induced by different

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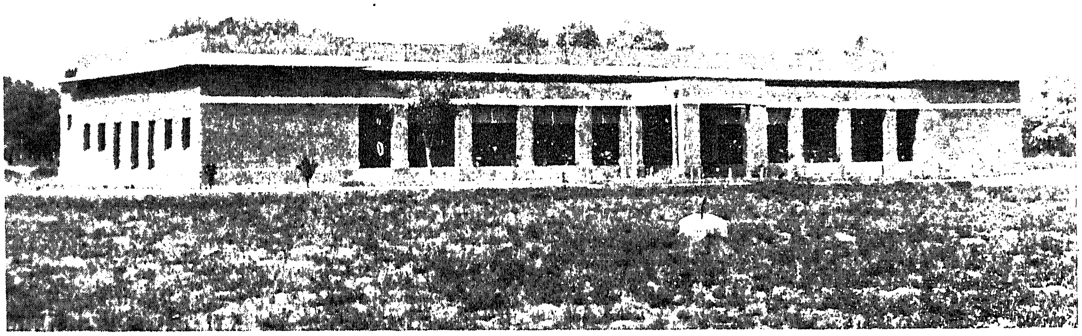

Poultry Research Section

The buildings, constructed at a cost of about Rs. 8 lakhs as a result of these decisions, comprise the Animal Nutrition and Poultry Research Sections. The main Animal Nutrition building contains several Physiological laboratories, where various techniques are employed in the study of the physiological effects induced by different

diets; Analytical laboratories; a Pathology laboratory; a Biochemistry laboratory; a Spectroscopic room; a Students' laboratory; a Special Work room; a Small Animals' room for small animal deficiency experiments; offices and an excellent library of works on nutritional science. The laboratories are well equipped with mills, gas and electric ovens, incubators, refrigerators, sterilizers and all other necessary apparatus. Near the Animal Nutrition building are Animal Nutrition stalls, a weigh-bridge, a post-mortem room and also a farm plot for experimental work on fodders. The Poultry Research building comprises a Poultry Marketing laboratory; an Egg Grading and Candling room; an Industrial Chemical laboratory; Pathological laboratories; a Biochemical laboratory, as well as a Library and a series of cold chambers with temperatures ranging from 0°–60° F. In connection with this aspect of veterinary research, a Poultry Farm on modern lines has also been developed for breeding, incubation and feeding experiments, the brooder house alone having accommodation for 1,500 chicks under electric hovers, while there are runs for 2,000 adult laying birds and the necessary replacement of young stock.

Research work on animal nutritional problems is of undoubted importance to India. The majority of Indian cattle are unthrifty and emaciated, among them mortality is high, sterility common and the milk yield of cows is low, all of which conditions point to malnutrition as probably the greatest single factor in their causation. Any improvement in the economic position of India and in the feeding of her people must largely depend upon raising the quality of her cattle and animal population, since India is predominantly an agricultural country and since food-stuffs of animal origin are now-a-days recognised as essential to human health. This improvement in animal husbandry must be mainly dependent upon the better feeding of livestock. It is, however, no easy task to provide fodder adequate both in quantity and quality. The husbandman is often hard pressed to find sufficient food for himself and it naturally follows that his animals must often be on very short commons, if not actually verging on starvation. It must, however, be realized that any expenditure on fodder for his animals will be more than repaid in larger supplies of milk, butter, meat and eggs. The first effort of the research worker must, therefore be directed to ascertaining the best possible use to which the food resources, which are or could be economically produced from the available land, can be put.

With regard to this problem, the Animal Nutrition Section aims at conducting experiments upon the different kinds of fodder available in India, their areas of cultivation their food value and the methods of preserving the excess fodder available during certain seasons of the year for use in times of shortage. Farm experiments will also be undertaken on indigenous and imported fodders with a view to improving the yield and quality of existing pastures and to discover the nutritive value of grasses at different stages of their maturity.

Another nutritional problem which will be dealt with is that of deficiency diets. It is already known that a shortage of certain minerals or vitamins in rations may lead to various disorders, such as bone diseases or blindness. It has also been shown that in many localities the necessary minerals are lacking in the soil and, therefore, also from the crops grown upon them. An analysis of the mineral contents of fodders, is consequently, to be undertaken and a map of India to be prepared, indicating the localities where pastures are deficient in minerals with the intention of demonstrating their relationship to the prevalence of certain diseases in those areas. Experiments will also be conducted to find how best these deficient diets may be supplemented to remedy their defects.

Digestibility and utilization experiments will be carried out with food-stuffs of all-India importance to determine the maintenance requirements of different types of animals; to discover the relationship between diet and milk, wool, hide or skin production growth and reproduction; and to study the physiological significance of the interrelation of food-stuffs. Further research will be directed to ascertaining the part played in disease by underfeeding and by improperly balanced or deficient diets; and, in the realm of toxicology, it is hoped to conduct a systematic study of plants known or suspected to be poisonous to live-stock and the effects of the ingestion of these upon animals.

The Poultry Research Section represents a direct attempt to develop a curiousl

neglected side of Indian agriculture. Poultry keeping could and should be an important addition to agricultural activity in a country, where the uneven distribution of crops enforces long periods of comparative idleness upon the farmer. Moreover, it has been clearly demonstrated that, intelligently developed, the industry could prove not only of great pecuniary benefit to the husbandman but of considerable economic advantage to the country as a whole. The indigenous fowl at present lays too small an egg for it to command anything better than local markets but the production of larger eggs would open up lucrative world markets to Indian produce.

The immediate policy of this Section is to build up a sound poultry stock which will provide material for research in various spheres, such as disease, genetics and marketing. Losses from disease among poultry are exceptionally high in this country and have, until now, not received the attention their importance merits. In view of the highly technical nature of disease research in poultry, an officer has been sent to England for a two years' special study course and it is hoped, on his return, that it will be possible to get to grips with these problems as they affect India and eventually to evolve adequate measures for the control of those devastating epidemics that periodically exterminate practically the entire fowl populations of different districts.

With a view to improving the type of fowl bred, experiments will be undertaken to determine optimum methods of incubating, brooding, rearing and feeding. Studies will also be conducted on the growth rate and rearability of imported hens, such as White Leghorns and Rhode Island Reds and a comparison of the data thus acquired made with known conditions regarding Deshi fowls. It should, thereafter, be possible to determine the type of bird best suited to Indian conditions. As the village producer is, and must remain, the backbone of the industry, particular attention will be paid to evolving methods of production that are suited to village conditions.

With a view to giving an impetus to the poultry industry as a whole, investigations will be carried out upon such matters as the grading of eggs for Indian and foreign markets; the preservation of eggs by pickling, cold storage, "guaranizing" and other processes; the preparation of table poultry; the best methods of packing eggs and poultry; and the possibility of introducing such articles as egg powder and egg pulp to the Indian market.

In addition to its research activities, the Poultry Department will act as a central information bureau in regard to poultry development and to all technical matters. A Library containing a representative range of scientific text-books, periodicals and bulletins is being built up, which should in time form a valuable collection on the various aspects of poultry rearing and marketing.

As His Excellency the Viceroy remarked in his opening speech:—"It is a matter of common observation that in the medical profession the progress of attention has been from cure of disease to prevention of disease and then to the establishment of health. ....The trend of veterinary activity presents a good example of this progress .... The third stage in the sequence .... (is) the establishment of health, which means, for veterinary purposes, the establishment of animal well-being and of the general conditions, which will strengthen the animal's resistance and improve its quality. The Animal Nutrition building represents, as it were, the realisation in brick and mortar of the full recognition of this important branch of veterinary science."

F. C. MINETT.

INDIAN AVIATION MAPS

THE subject of maps as used in aviation and the kinds best suited, more particularly with reference to India, was discussed very fully in the serial "Shall we learn to fly" which appeared throughout 1939 and early 1940 in "*Mysindia*", published in Bangalore. There it was observed that of the various scales published, the most generally suitable for aviation had been found to be the scale 1/1,000,000 or 15¾ miles to the inch, called for short the million scale, the maps being known as "million maps"; though some aviators prefer the next smaller scale, 1/2,000,000, since one sheet of the same size in that scale covers four times as much area of country, and hence fewer sheets are required to be carried around and less frequent manipulation is called for. The Survey of India publishes on this smaller scale an excellent series called the "Southern Asia Series". It is a layered series and that in a very effective range of colours.

However, to return to the million maps: The Survey of India publishes two great series of these, the earlier established "India and Adjacent Countries Series" and the later, but by no means to be inferred more up to date, "Carte Internationale du Monde Series", both on the same projection. The former are square sheets with the mapped area measuring 4 degrees of latitude by 4 degrees of longitude and the latter are oblong sheets with the mapped area measuring 4 degrees of latitude by 6 degrees of longitude (and a degree of latitude equals 60 sea miles or 69 statute miles). The former series is, or rather was, published in two editions, the political and the layered, the layered being now, alas, out of print. The latter series, the "International" for short, is in a layered edition only, but what a contrast to the other layered edition! And by layered, perhaps, it would be as well to explain, is meant layers of colour, apparently superimposed, to indicate the height of the ground above sea-level. Altogether cruder is the International series, in which a flat green is used for land at or near sea-level and a flat brown for everywhere else; with very little to indicate the presence of great hills and nothing at all to indicate their shape; or even the mere presence of little hills. Actually the green and the brown are graded in various shades, lighter to deeper, but this is scarcely apparent and one is led to suppose, unless one looks very closely indeed, that India is one vast undifferentiated table-land of unspecified altitude surrounded by a fringe of dead level maritime plain unrelieved by any hill. And this is the map series chosen as the basis for India's aviation maps. Indeed it is simply *hey presto!* by the addition of a few symbols to indicate landing grounds, aerodromes, factory chimneys and so forth (which features of course are only too apt to continue multiplying after publication of the map in which they appear) that this series is transformed into aviation maps; for in all other respects it is the International Series and nothing more—with heights given in metres too, whatever a metre may be. Can any honest Briton or Indian be expected to know. Anyway the altimeters on aeroplane dash boards give heights in feet—in British and American aeroplanes at all events.

As regards the India and Adjacent Countries Series, the now extinct layered edition (where specimens of the maps are still to be found) is a veritable work of art, presenting as it does the illusion of an exquisitely modelled relief map, every hill and range whether big or small boldly standing out in its natural shape as actually seen from the air, so cleverly has the contouring and shading been done; and the choice of colours for the layering has been a stroke of genius, revealing as it does at once the altitude above sea-level unmistakably of any part of the country and making of each sheet a picture pleasing enough to be framed and hung on a wall. And now all that labour and ingenuity gone into limbo. A regular decline and fall. As the early Hebrews used so dejectedly to moan, "Ichabod", meaning "the glory hath departed". The political edition is (or was) an exact replica of the layered edition except for the absence of layer colouring and for the substitution of political boundaries in yellow. The contouring and shading of hills is (or was) absolutely identical, but in other respects it is a white edition in contrast to the other which was essentially a coloured edition. Both these editions of the India and Adjacent Countries Series are vastly superior to the International Series from the point of view both of the aviator and of the man down below, particularly of course the very picturesque extinct layered maps, but the white maps are ideal for enabling track lines to be ruled in pencil and to remain visible thereafter; and heights in both are given in familiar feet.

Alas though and here the story turns sombre again. Once more one groans "Ichabod". Have we not as children played that pencils-and-paper game in which someone draws some simple sketch, *e.g.*, of a pig, and passes it along to the one next alongside to copy and to pass the result along again to be copied by the next one and so on. The final picture was rarely recognisable as a copy of the first. So with map copyists as million edition passes to million edition, though with not quite so appalling result. New features it is true are entered such as roads and railways that have been built since the publication of the previous edition, but the old original features suffer. Rivers and streams lose their characteristic bends, some even their very character itself, roads become rivulets, rivulets join the main stream at the wrong place, lakes lose their characteristic outlines and some vanish altogether, contours lose their careful precision and those of small hills collapse into vague hatchuring, and so on the sad tale goes. This fate has not befallen the maps of the layered edition of the India and Adjacent Countries Series, simply we must suppose because it was decided long since to discontinue its publication, but it has befallen the maps of the political edition and, to an even greater

extent, those of the International Series. The new political maps are nothing like so good as the old, but nevertheless they are still greatly to be preferred to the maps of the International Series; and after all if an aviator wants his maps to show aerodromes and things there is nothing to stop him from referring to sources of information and entering the symbols himself with his own hand when he has a few moments to spare. And for the aviator who is a collector of rarities there may yet be available in odd and musty map stores copies of the old layered and political editions, now so definitely qualified to be included in the category of early treasures.

To come now to cases and to bring the story nearer home.

(*i*) Madras is situated at a point on the coast south of which for 50 miles sprout a profusion of small isolated hills anything up to 500 feet high, and north of which sprouts but one small hill in 150 miles. The erring aviator making for Madras either from inland or from out to sea and striking the coast within 50 or 60 or 70 miles of Madras if he be aware of the topographical situation as just described is informed promptly thereby in which direction to turn in order to reach Madras. The India and Adjacent Countries Series map, however recent the edition, shows the situation as described. The International map shows a complete absence of hills equally north and south of Madras; and remember, the International map is the aviation map. (*ii*) An isolated and prominent hill, a thousand feet high, near Wandiwash, a landmark for miles, is not shown in the International map. Nor are the very considerable hills near the Madras Civil Aerodrome. Of what use then to go to the labour of indicating factory chimneys? (*iii*) Coming from Calcutta an aviator new to the route found himself to his bewilderment amongst isolated abrupt hills in the vicinity of Cuttack where his map showed none. It was an International map. (*iv*) Lastly it is illuminating to observe how the two series deal with Kolar Gold Fields, the truth to detail in the one and the extreme casualness to say the least displayed by the other. With aeroplanes and all their accessories steadily improving as the years roll on it is depressing to reflect that Indian maps available for aviators should be so definitely deteriorating; apart, of course, from the pretty symbols to show what most aviators in India anyhow know already, *e.g.*, that there is a civil aerodrome at New Delhi, equipped with all modern conveniences, that there is an R.A.F. landing ground at Bellary and so forth.

Actually the aviation maps for Great Britain and doubtless some other parts of the world are very good indeed. In them colouring is employed not for layering but to imitate actuality, *e.g.*, dark green for woods, and care is taken that the shape of each wood shall be accurately entered and that the map shall be in every way as clear a picture as possible of what the aviator will see. This sort of thing would be too big a task altogether for India where forests and scrub are of vast extent and without either clear definition or shape, merging as they do by gradual degrees into cultivation or wasteland, but on the other hand the old layered edition of the India and Adjacent Countries Series, if brought up to date and not spoilt in the process by slipshod copying, would make an ideal aviation series. In the meanwhile aviators will do well to avoid the official aviation maps and choose the political maps of the India and Adjacent Countries Series instead, which for all their deterioration of late years are really quite good enough.

VITAMIN E—A SYMPOSIUM

Vitamin E—a Symposium. The Food Group (Nutrition Panel). (Society of Chemical Industry, London), 1939. Pp. viii + 88.

SINCE the discovery of Vitamin E in 1922, there has been a very large volume of work on the various aspects of the vitamin, chemical, analytical, physiological, clinical and therapeutical. The Nutrition Panel of the *Society of Chemical Industry*, organized a symposium in April 1939, before which some of the most prominent workers in the field, have presented their contributions. The present volume representing the proceedings of the symposium, constitutes a valuable summary of our knowledge in a highly important biochemical field. Special attention should be invited to the contribution by Professor Karrer, who deals with the synthetic analogues and homologues of Vitamin E and discusses the stability of tocopherol and tocopherol esters. Part II of the volume which deals with the physiological action of Vitamin E and the consequences of Vitamin E deficiency, will prove intensely interesting and illuminating to the medical profession who have to deal with cases of sterility. Veterinary doctors and animal breeders will find plenty of useful and practical information in Part III of the volume which is devoted to a discussion of the clinical and veterinary uses of wheat germ oil and Vitamin E preparation.

The *Society of Chemical Industry* should be congratulated not only for organizing this symposium but also on the production of this volume which will command the attention of a wide circle of investigators and which will stimulate further research on this important vitamin.

M. S.

CENTENARIES

Chambers, Ephraim (1680–1740)

EPHRAIM CHAMBERS, an early English encyclopædist, was born of a farmer at Kendel in 1680. Having received his education at Kendel and London, he apprenticed to a map and globe-maker and while thus occupied he took up the compilation of a cyclopædia on a larger scale than that of John Harris's *Lexicon technicum* (1704).

The Cyclopædia

Chambers published his *Cyclopædia: or an universal dictionary of arts and sciences, etc.*, in 1728; he endeavoured to connect the scattered articles relating to each subject by a system of references based on a specially devised scheme of classification and "both to treat them as so many wholes and so many parts of some greater whole". Immediately after its publication, he was made a Fellow of the Royal Society. It went through several editions and translations. The sixth edition (1750) contained two supplementary volumes compiled by Sir John Hill, the botanist, and George Lewis Scott, the mathematician. It formed the basis of the more extended cyclopædia of Rees which was completed in 45 volumes in 1819. It may be said that Chambers's work originated all the modern cyclopædias.

Chambers lived to the last the life of a recluse and a hard student, reading and writing from morning to night almost without intermission. A person who was his amanuensis for six years is said to have stated that "he transcribed for him and took down from his dictation in that space of time, not less than twenty large folio volumes as those of his *Cyclopædia*".

Chambers died at Islington, May 18, 1740.

Rockwell, Alphonso David (1840–1933)

ALPHONSO DAVID ROCKWELL, an American physician, was born in New Canan, May 18, 1840. He began his medical studies with a local practitioner and having seen service in the army for a few years settled in New York in 1865 for practice.

Electrotherapeutics

In 1866, he collaborated with George M. Beard in the investigation of the therapeutic applications of electricity. At this time electricity was not used to any extent by physicians in the United States and very little elsewhere. It is their pioneer *Medical use of electricity* (1867) which created general interest in the subject. In 1871 they brought out their *Practical treatise on medical and surgical uses of electricity* which went through eleven editions and several translations. Here they described exhaustively and with illustrative case reports the *modus operandi* of general electrization which they had been the first to investigate. In 1886 Rockwell was made professor of electrotherapeutics at New York Postgraduate Medical School. He was also elected President of the American Electro-Therapeutic Association.

Electrical Chair

When the New York State law was enacted changing the method of legal execution, Rockwell was chosen as one of a committee to advise the State upon the apparatus known as the electrical chair. He was a witness of some of the earliest electro-executions in the State.

Rockwell died, April 12, 1933.

S. R. Ranganathan.

SCIENCE NOTES AND NEWS

Discovery of Carved Heads in Mexico.—Five colossal heads carved in human form from basalt, each weighing 20 tons or more, have just been discovered in the Tehuantepec Isthmus region of Mexico by a joint archælogical expedition of the *National Geographic Society* and the *Smithsonian Institution*. The expedition was headed by Matthew W. Stirling, Chief of the Bureau of American Ethnology of the Smithsonian Institution. So far, the expedition's excavations have failed to uncover any evidence to indicate the age of the gigantic carvings or what part they played in the religious life of their creators.

According to a Communique issued by the *National Geographic Society*, the heads were found near the small village of La Venta in the western edge of the State of Tabasco, about 20 miles from the coast of the Gulf of Mexico. They lay within an area about a quarter of a mile square, and all were almost completely covered by soil.

The newly found sculptures are similar to the single colossal head unearthed in 1939 by the same expedition at Tres Zapotes, Vera Cruz, a hundred and twenty miles to the west. This was the first of the mysterious big heads to be fully excavated and photographed. The existence of one partially buried head at La Venta had been reported in 1925 by a Tulane University expedition led by Frans Blom; but it was not suspected that five of the huge carvings existed until Mr. Stirling visited the site last month.

The five colossal heads of La Venta vary in height from 6 to 8 feet 5 inches, and in circumference from 13 feet 7½ inches to 21 feet 7 inches. It is estimated that the weight of the largest may exceed 25 tons. The archæologists have as yet found no source of basalt nearer

'0 miles. Two of the unsolved prob- connection with the heads are, where ere made and how the huge, heavy of stone were transported to their pre- es in the swampy coastal plain.

* * *

American Rhinoceros.—A joint palæonto- expedition of the *National Geographic* and the *South Dakota State School of* is now on the field in the Badlands Western South Dakota, seeking the of the queerest creatures—protoceras, ere and other New World types of ·os—that roamed the plains of North ι—some thirty millions of years ago. llands area, once a grass covered region ng plains, has undergone, during all ;es, radical changes and is now covered rge quantities of eroded materials and ash. Erosion during the last 10,000 ıd more, has exposed several bones and :losed the region to be a rich treasure- or palæontological investigations. Many f vertebrates have been "mined" there the past three quarters of a century. ong them only a few complete skeletons cthere, protoceras and rhinoceros have ·covered. According to a communique ıe *National Geographic Society* dated 4, 1940, the expedition's chief aim will examine this region thoroughly; it is l that the bones of many other animals found also.

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iah Horrox (1619-41):—A biographical interest has appeared in *Occasional* r December 1939 (*Royal Astr. Soc.*, 1939, This refers to Horrox, Curate of Hoole ashire, who, to quote from the inscrip- the monument erected in his honour minster Abbey (1874), "in so short a ected the long inequality in the mean of Jupiter and Saturn, discovered the the Moon to be an ellipse, determined tion of the lunar apse, suggested the cause of its revolution and predicted ıis own observations the Transit of

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dation of Chemical Reactions.—Work retardation of oxidations in the liquid as been proceeding actively for the last years, and yet unfortunately the worker eks an inhibitor for an oxidation not examined must still be guided almost by trial and error. Kenneth C. Baily collected the most important data on hase oxidations in 10 extensive tables Roy. Irish Academy*, 1939, 45 B, 373) to he worker may refer to discover what s have been tried in a given case, and hat results. Although the compilation ables has been an end in itself, an at- ıas been made to draw some general ons, however limited they may be, in plicability.

* * *

tials of Photomicrography.—A general of the general principles of microscopy otomicrography is given by Max Poser Bausch and Lomb Optical Company, Rochester (*Phototechnique*, Feb. 1940). Enormous amount of research has been done in recent years on various aspects of the construction and working of the microscope and the author presents these in a general manner and in nontechnical language. The differences between the various light sources are discussed and methods to eliminate glare are suggested. For this purpose the employment of an adequate light filter is advised by the author, the selection of the correct colour of the filter being easily determined by means of a small hand-spectroscope manufactured by the Bausch and Lomb Optical Co. The enormous advantage of ultra-violet light as source of illumination over ordinary types of light sources is discussed, especially for photomicrographic purposes. Practically twice the resolving power of a given numerical aperture can be achieved by using ultra-violet light of the cadmium line. This fact is bound to revolutionise future work. But it is essential that the entire optical system in this case, including the slides and coverglasses should be made of quartz, since glass is opaque for this short wavelength. The determination of the magnification of a photomicrograph is also explained. The paper is illustrated with excellent photomicrographs. Those, especially of the mitotic figures, are amongst the clearest ever published.

* * *

Preservation of Wall Paintings.—A process consisting of what is called "application of a reverse humidity gradient", has been evolved by the Archæological Chemist with the Government of India, for preserving the celebrated wall paintings from Central Asia, now on exhibition in the Central Asian Antiquities Museum, New Delhi. The deterioration of these paintings has been traced to the presence of injurious salts in the materials originally employed. Variations of atmospheric humidity in the museum galleries causes the salts to go through a continuous cycle of solution and crystallisation, resulting in the decay of the plaster.

The process employed for restoring and preserving the panels consists in mounting them on the sides of a humidity chamber, with the painted surface exposed inwards to a relative humidity of over 85 per cent. Wet paper pulp is applied to the outer (plaster) surface of the panels. The layer of pulp, which removes the salts by absorption is removed when dry; the treatment is repeated, until the concentration of salts in the plaster is reduced to a negligible fraction. The paintings are then taken out of the chamber, the surface coated with vinyl acetate solution to strengthen the decayed surface and to fix the colours and finally the surface is pressed down carefully with hot iron.

* * *

Fight against Soil Erosion in India.—We are gratified to note that energetic steps are being taken by the *Imperial Council of Agricultural Research* to fight the problem of soil erosion in this country which here, as in other parts of the world, has led to disastrous consequences of a permanent character to the cropping power of the land. Controlled grazing, contour trenching and bunding are among the methods that have been adopted in India to attack soil erosion

and some results of practical value are reported from various parts of the country, where the methods have been under trial for some considerable time. Recommendations have also been made for the formation of anti-erosion Provincial Boards and an All-India Anti-Erosion Committee to tackle the problem systematically and to bestow continuous attention to the subject. Among examples of successful attempts are mentioned certain experiments in the U.P. where the regulation of grazing resulted in a great improvement in the quality and quantity of fodder grasses and indigenous trees and shrubs, encouraging their natural rejuvination and effectively preventing soil erosion and the formation of ravines. It was also found that the cutting of grasses twice or thrice a year yielded much more than a single cutting at the end of the season, that closure to grazing alone resulted in increasing the yield of fodder grasses from three to fifteen maunds per acre and that grass samples from enclosed areas were greatly superior in quality to the grass from the ordinary hillsides. A notable example of large-scale contour trenching is that carried out in the Singbhum District of Bihar where a distance of 25 miles has been covered with encouraging results. Contour trenching combined with controlled grazing has resulted in striking increases in the yield of grass. These methods are also useful in mitigating the danger of floods, and the Governments of Bengal and Orissa are said to be looking to these methods as practical expedients. In Bombay much has been done by that Government for popularising the methods of constructing field bunds for preventing erosion and in the Punjab the Government has accepted a proposal for the grant of remissions of assessment as an inducement for the adoption of the practice by cultivators. A. K. Y.

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Jute Research in India.—(1) A somewhat surprisingly quick result following the establishment recently of the Jute Research Laboratory of the *Indian Central Jute Committee* is published in a press note issued by that Committee. It relates to the infection of the jute seed by Macrophomina (Rhizoctonia). It is now said to have been definitely established, that the infection is carried *within* the capsularia seed as well as on its surface. This source of infection was hitherto unknown in jute. The strain called D. 154 proved infected to the extent of between 12 and 15 per cent. and 4 to 6 per cent. of the seeds carried the infection within the seed, the balance being due to the infection of the outer surface of the seed-coat. The incidence of the disease in a crop of D. 154 on the Dacca Farm was found to amount to 20 per cent. of the plants. (2) The lines on which the Committee is working out an accurate method of forecasting the jute crop forms the subject of another press note and the random sampling method recommended by Prof. P. C. Mahalanobis for this purpose have won both approval and high commendation from the well-known American Economic Statistician, Prof. Harold Hotteling who examined and reported on the scheme. "No technique of random sampling", says Prof. Hotteling, "has so far, as I can find, been developed in the U.S.A. or elsewhere which can compare in accuracy or in economy with that described by Prof. Mahalanobis"—high praise which sets the seal upon a method which offers a practical solution to a knotty problem. (3) A third press note of the Committee draws attention to the decision arrived at during the last meeting of the Committee to conduct research on jute blended with flax. In view of the urgency of the flax question and the possibility of India capturing a share of the flax market, not only now but in perpetuity it has also been thought desirable to install machines as soon as possible for thoroughly testing such flax as may be grown in India in the season 1940–41. A. K. Y.

* * *

Control of the Pyrilla Pest on Sugarcane.—An interesting contrivance by which the biological method of controlling this pest can be greatly enhanced in its effectiveness has been devised by the Biological Control Research Officer at the Palhera Farm near Meerut Cantonment (*Indian Farming*, March 1940). The device consists in enclosing egg masses of pyrilla, both parasitised and healthy, in small portable wooden cages with wire-gauze panels, the gauze having 90 meshes to the square inch, and then distributing these cages in different parts of the field. The mesh is found large enough to allow the parasites to fly out on emergence but too small for the exit of the pyrilla nymphs. It was observed that all parasites emerging from the parasitised eggs in the cage flew out into the field through the meshes of the gauze while hundreds of pyrilla nymphs emerging from healthy eggs were trapped in the cages and perished. The parasites were thus helped to tide over their numerical weakness and thereby to gain very materially in their power as a controlling agent. In the experiment reported the percentage of parasitised eggs in the field rose from 30 to well over 60 in the course of three weeks, as the result of the new contrivance. The method has also been found applicable to the parasites attacking pyrilla in the winter, which are different from those described above. A. K. Y.

* * *

New Salt Find at Sambhar Lake.—Deposits of common salt have recently been found near the Sambhar Lake, and vast quantities of this material are now being scraped out in a form ready for the market. The area from which the salt is now being scraped out, has been functioning as the main bitterns-area for the surrounding kyars or collection of manufacturing pans. For years and years the refuse liquor (or bitterns) is being thrown away into this area.

Ordinarily, after the rains, this area remains covered with brine, but this year, owing to dificiency in rainfall, the whole of the deposit lay exposed and its exploration led to the discovery by Mr. Rahim Baksh, Superintendent in the Northern India Excise and Salt Department at Sambhar, of a regular layer of crystal salt of good quality about 3″ in thickness, beneath 1″–2″ thick crust of impure salt, which was easily removable from the top. On excavation by normal methods, the layer breaks up

easily into separate and well matured crystals, medium and large in size, and absolutely white in colour. Washed with condensed brine, the salt attains a purity which compares very favourably with the ordinary salt manufactured or mined in India, or imported from abroad, the percentage of sodium chloride varying between 95 and 99. Even in unwashed samples, the percentage is 92 to 97.

It is anticipated that in the edge of the area where crystal salt has been discovered, there is about 10,00,000 maunds of powdered salt.

* * *

The Comparative Strengths of Some Important Indian Timbers and their Uses.—The publication of the booklet by Mr. V. D. Limaye (*Indian Forest Records,* New Series, Utilisation, Vol. 1-A) is opportune just now when it is of urgent national importance to replace, with suitable substitutes, some of the conventional timbers hitherto imported in large quantities to Great Britain. Apart from durability and, of course cost, the strength factors of timbers constitute limiting factors in many forms of utilisation; and Mr. Limaye has presented here the strength data of about 36 common Indian timbers (and also of six commonly imported timbers) in a simple and vivid manner by adopting the method of "Stick diagrams" with the corresponding Teak value arbitrarily taken as 100. Short explanatory notes indicating the distribution of the species and the uses for which the timber is suitable add to the value of this publication which should be welcome to engineers and laymen alike as a sort of "Who's who?" in Indian timbers.

EMMENNAR.

* * *

Handedness in Inheritance.—It has now come to be recognised that handedness is a quantitative and therefore a graded trait. No simple Mendelian explanation accounts for either right- or left-handedness but the more frequent occurrence of left-handedness as a familial trait is clearly noticeable. This phenomenon is discussed by D. C. Rife in a recent paper (*Genetics*, 1940, 25, No. 2). If one of the parents is left-handed, it is more likely that children are also left-handed than if both parents are right-handed. And if both parents are left-handed about 50 per cent. of the children are left-handed. In twins of both mono- and dizygotic kinds left-handedness occurs more commonly and frequently among twins one member is right-handed and the other left-handed. Even so, twins where one member is left-handed have a higher percentage of left-handed relatives than pairs composed only of right-handers. It is believed that handedness being a quantitative trait, many individuals are genotypically intermediate and may be influenced either way by environmental conditions. More left-handedness can be expected among the relatives of genotypically intermediate twins than among the relatives of genotypic right-handers.

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Toxicity of Lead Arsenate to a Leaf-feeding Insect.—Many insects feed upon a variety of host plants,—certain of which appear to be inferior to others as a diet. The effects of different diets of this type are often apparent in the rate of growth of the insects, the fecundity of the adults, the resistance to disease and even in the pigmentation of the individuals. These physiological variations have been noted from time to time, by Mr. M. C. Swingle of U.S. Department of Agriculture, in the case of the southern armyworm, *Prodenia eridania* Cram. (*J. Econ. Ent.*, 1939, 32.) It appeared possible, therefore, that other physiological changes may have occurred, which would result in a change in the resistance of the insect to certain insecticides. A short series of tests made by him definitely showed that the resistance of southern armyworms to lead arsenate could be controlled by previously feeding them with particular species of plants.

Further research in this direction is expected to considerably add to the knowledge of better utilization of insecticides in the control of harmful insects.

* * *

Tellurium in Tin Alloys.—It was shown by Dr. Hanson and Dr. Pell-Walpole some time ago that a little tellurium improves the creep strength of pure tin, both in the rolled and the cast conditions. A convenient method of determining tellurium in these alloys has been worked out by Dr. Pell-Walpole. He ascertains the loss of weight that occurs on distillation *in vacuo* when tin telluride (TeSn) distils without dissociation. A note of the method forms Publication 96 of *The International Tin Research and Development Council.*

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The Inter-University Board has rendered valuable service to the cause of higher education in India by publishing the report of the Proceedings of the 15th Annual Meeting (1940). This body of educational experts have considered several outstanding problems in university education, and in many cases they have offered wise and practical solutions. They have set up, as it were, certain sign-posts in educational thought and administration, certain goals towards which effort may be directed. Thus, for instance, Dr. C. R. Reddy in his welcome address to the assembly, makes a powerful plea for harnessing the resources of Indian Universities towards practical ends in industry and commerce. He sees a great opportunity in the present war for doing this, since supplies of technical products from the advanced countries of Europe are now cut off.

Among other questions of general interest brought up at the Conference was the problem of separate courses of study for women candidates in Indian universities. This is an important matter regarding which certain universities have already made some headway; but the lead given by the Board in favour of this step is likely to strengthen the hands of these pioneers. Another valuable suggestion, supported by no less a scholar than Sir Jadunath Sarkar, aims at bringing about a closer association between historical research departments of Indian universities and the Imperial Record Department of the Government. That this is a very desirable move will be admitted by all students of Indian history. In recent years the contribution of Indian savants to our knowledge

of India's past has been steadily expanding; but this expansion can be greatly accelerated by affording improved facilities for research on the lines suggested in the proposal.

A matter of, perhaps, less general interest, but nonetheless an important matter from the point of view of educational administration, is the status of Cambridge School Certificate Examinations in relation to university studies in this country. Not only Anglo-Indians but many Indian boys and girls are now appearing for these examinations. It is therefore urgently necessary that there should be some uniformity of practice among Indian universities as to the treatment of these candidates.

Finally it may be observed that the already useful work of the Inter-University Board may be further enhanced by providing a conspectus of the arrangements existing in the various departments of Indian universities. A beginning has already been made in this direction in regard to certain faculties such as Education and Law. These studies may be extended to other faculties as well as brought up to date from time to time.

Such an effort will help to bring about greater uniformity in university arrangements. It is not suggested here, however, that absolute uniformity of practice throughout India is either practicable or even desirable. Nor has the Board any statutory authority for co-ordination, its resolutions being no more than mere recommendations. But still, there are certain matters in regard to which voluntary uniformity may be attained. For this purpose a knowledge of what is going on elsewhere is necessary. The Board may legitimately provide this knowledge. Perhaps the suggestion of Mr. N. S. Subba Rao, advocating more stable foundations for the Board, will be helpful in this connection.

D. S. GORDON.

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Research Institute, Ayurvedic and Unani, Tibbi College, Delhi.—The annual report of the Director for 1938–39, gives an account of the work on some of the drugs carried out by Director S. Siddiqui and his colleagues. *Ayurvedic* and *Unani* systems of medicine possess many valuable and efficient drugs still unknown to Western science, and this Research Institute has the commendable object of bringing them to the knowledge of the scientific world and placing the use of these drugs on a modern scientific basis, by investigating the nature of the active principles whose potency is responsible for the curative property of the drug. This is a long and arduous task, requiring patience, skill and technique of a high order. Director Siddiqui "has tackled these difficult problems energetically and has achieved results of great value to medical science."

It is noteworthy that many of his colleagues have obtained their doctorates from other Universities on the strength of their work at this Research Institute, which is just becoming a centre for work on drugs. We hope that this Institute will obtain greater and a more practical recognition. We wish to congratulate the Director on the excellent work carried out at the Institute.

* * *

Indian Forest College, Dehra Dun.—The first annual report of the College (1938–39) just issued, emphasises the importance of training future forest officers in India, and invites attention to the special facilities existing for such training at Dehra Dun. Sixteen students representing different parts of India are undergoing training at the College. Central Provinces, Mysore, Travancore and other States are not represented at the College. The practice of forestry differs in different parts of the world, and a comparative study of these methods would be extremely valuable. Some of the best authorities on Forestry in England have had their rich and extensive experience in India and Burma. It would be to mutual advantage if a system of exchanges between the forest services in various parts of the Empire could be introduced.

* * *

The Imperial Council of Agricultural Research has recently issued a valuable Bulletin on Chalcids (*Misc. Bull.*, No. 30), summarising all available information on the natural habitats of these parasites and the variety of hosts attacked by them. Nearly 200 parasites are dealt with and all information available about their distribution and life-histories is included. A host-parasite index is also given.

The Bulletin does not deal with all the parasites which actually occur in the country, as a large number of them, accumulated in the Laboratory of the Imperial Entomologist at the *Imperial Agricultural Research Institute*, New Delhi, have not yet been identified. A supplement to the Bulletin will be issued as the mass of unnamed parasites in the Imperial Pusa Collection is worked out.

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An Inventions Board for Canada.—An Inventions Board has been established by the Government of Canada to deal with the growing volume of inventions and suggestions intended to further Canada's war effort which are being received by the various departments of Government.

The establishment of the Inventions Board provides a means whereby ideas and inventions submitted by citizens of Canada and abroad can be carefully examined, and promising proposals cleared to the proper authorities.

Dean C. J. Mackenzie, Acting President of the *National Research Council*, is the Chairman of the Board and Mr. S. J. Cook, Officer-in-Charge, Research Plans and Publications Section, *National Research Council*, the Secretary. The other members are, Lt.-Col. K. S. Maclachlan, Col. H. Des Rosiers and Mr. W. R. Campbell.

All proposals received will be considered in the first instance by the Examining Committee. Those which offer promise will be reviewed by members of the Consulting Panel, and the proposals which meet with the approval of these two groups will then be considered by the Board.

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The next outburst of sunspots should occur early in 1944 and the next maximum of sunspots should come in the summer of 1948. Communicating this forecast in a letter to the

Editor of the *Physical Review*, of June 5, 1939, J. R. Stewart and F. C. Eggleton (Princeton Observatory) stated that since 1749 A.D. sixteen sunspot cycles have been completed. The seventeenth is not yet complete. The next one may be expected to commence roughly two-thirds of a year after the sunspot number has fallen to one-tenth its maximum value. This places the date early in 1944. The new forecast is made by fitting curves to the graphs made in plotting the number of sunspots monthly.—(*Bull. Amer. Met. Soc.*, 1940, 21, 117.)

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Weather Reports from America.—Two 2,000-ton Coast Guard cutters, with meteorologists of the *United States Weather Bureau* on board, have been ordered to permanent stations in the Atlantic, one one-third and one two-thirds of the way from Bermuda to the Azores. The equipment provided includes balloons carrying instruments for measuring pressure, temperature, and humidity, and the ships will report weather conditions direct to Washington. This step has become necessary in view of the scarcity of radio reports from ships at sea due to the present political situation in Europe. Because of the war, both belligerent and neutral vessels have silenced their radios, thus cutting down greatly the number of meteorological reports and rendering difficult the preparation of the usual weather maps of the north Pacific coast.

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The Health Organisation of the League of Nations.—At a meeting of the *Emergency Sub-Committee* held from March 4th to 10th, several medico-social questions arising out of the movements of civil populations were considered and a report dealing with (1) measures to be applied before transfer, (2) the action to be taken during the move and (3) the working of the welfare and medico-social assistance services in the reception areas, was adopted.

Among other questions considered at the meeting was one relating to the increase of cases of *cerebro-spinal meningitis* in several European countries. In recent years, the curve of incidence of cerebro-spinal meningitis in Europe and in the United States of America has displayed annual variations which themselves fluctuate in cycles of from 8 to 12 years. The last peak was reached in 1928–29. During the first two months of 1940, the seasonal increase in England, Switzerland, Germany, Austria, Hungary, Bulgaria and Yugoslavia, was greatly in excess of that normally recorded in those countries. It is characterised by the very wide dispersion of sporadic cases, the absence of epidemic foci and a decline of the fatality rate.

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Entomological Society of India (Bengal Branch).—Mr. D. D. Mukerji has been re-elected President of the Society for the year 1940–41 and Dr. D. P. Raichoudhuri, Secretary.

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University of Mysore.—The annual meeting of the Senate was held on the 1st March 1940. Among the propositions that were passed mention may be made of the following: (1) The adoption of Budget Estimates of the University for 1940–41. (2) Transitory Ordinance relating to the admission of passed S.S.L.C. candidates with an optional group selected from Group C or D to the Intermediate course in Arts. (3) Grant of exemption to students belonging to the depressed classes from payment of tuition fees and examination fees for a further period of 5 years, *i.e.*, up to the end of academic year 1944–45. (4) Levy of fees for tuition on Mysorean women students in the Arts and Science Colleges at half the prescribed rates and of full fees for examinations. (5) Courses of studies and schemes of examination in Geography for the Intermediate and the B.A. and B.Sc. Degree Examinations. (6) Courses of study and scheme of examination in Hindi as an optional subject for the B.A. Degree Examination. (7) Addition of 'Urdu' to the list of major subjects which may be offered for the B.A. Honours Degree Examinations. (8) Amendment of Ordinance relating to the Master's Degree Examination permitting a thesis to be offered in lieu of all the four papers. (9) Division of the second examination in Engineering into two examinations. (10) Reduction of the minimum to be obtained for a pass in English at the Intermediate Examination from 40 per cent. to 35 per cent.

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The Syndicate of the **Calcutta University** has recommended that Prof. Bidhubhushan Roy, D.SC., may be reappointed *Khaira Professor of Physics* and that he may be permitted to serve in that capacity till he completes his sixtieth year.

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MAGNETIC NOTES

April 1940.—Magnetic activity during the month of April 1940 was much less than that during the previous month. There were 13 *quiet* days, 13 days of *small* disturbance and 4 of *moderate* disturbance as against 4 quiet days, 21 days of small disturbance, 3 of moderate disturbance and 2 of great disturbance during the month of April 1939.

The day of largest disturbance during the month was the 3rd and that of least disturbance the 10th. The magnetic character during individual days is given in the table below.

Quiet days	Disturbed days	
	Slight	Moderate
6–10, 16–19, 23, 27, 29, 30	2, 4, 5, 11, 12, 14, 15, 20–22, 24, 26, 28	1, 3, 13, 25

There was only one storm of moderate intensity during the month as against 4 storms (2 of moderate and 2 of great intensity) during April of last year.

The mean character figure for the month is 0·70 as against 1·03 for the same period of last year.

M. R. Rangaswami.

SEISMOLOGICAL NOTES

During the month of April 1940, two slight and three moderate earthquake shocks were recorded by the Colaba Seismographs as against

Date	Intensity of the shock	Time of origin I.S.T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
1940		h.	m.	miles		miles	
April 1	Moderate	16	49	4700	Near 2° S., 139° E., in the vicinity of New Guinea		
,, 6	Slight	19	13	2130	Near 27° N., 105° E., in South China		
,, 13	Slight	12	01	2230	Anatolia ?		
,, 16	Moderate	11	38	5630	Near 55° N., 178° E., in the Bering Sea		
,, 16	Moderate	12	13	5590	Probably the same as above		

three slight, one moderate and two great shocks recorded during the same month in 1939. Details for April 1940 are given in the above table.

ASTRONOMICAL NOTES

Planets during June 1940.—Both Mercury and Venus will be visible as evening stars during the month; the former reaches greatest eastern elongation (25° 18′) on the 24th, when it sets about an hour and a half after the Sun. Venus which is rapidly approaching the Sun will be at a stationary point of its orbit on June 4. It then begins to move in a retrograde direction and after reaching inferior conjunction with the Sun on the 26th, becomes a morning star at the end of the month. Mars is gradually getting fainter and is an inconspicuous object in the evening twilight.

Jupiter will be visible as a morning star rising about three hours before the Sun. Not far from it is Saturn which rises about a quarter of an hour later. The rings will be seen considerably widened since the time the planet was last observed in the evening sky. Uranus is slowly moving in the western border of the constellation Taurus, about six degrees to the south of the well-known cluster, Pleiades. There will be a close conjunction of the Moon with Saturn on the night of June 30.

The Milky Way.—Many of the interesting parts of the Milky Way can be conveniently observed in the early part of the night during the month. The regions in the constellations Cygnus and Aquila as well as the star clouds in Sagittarius are amazingly rich in faint stars, and will well repay a careful study. Between Cygnus and Scorpio the Milky Way divides itself into two narrow streams running parallel to each other. The obscure patches, the dark rifts and lanes that are found in the constellation Ophiuchus and other places also deserve special attention. These are regions apparently devoid of stars where occur large patches of obscuring clouds cutting off the light of the more distant stars in the background. These dark clouds are objects comparatively near our system at distances ranging from three hundred to two thousand light years. T. P. B.

ANNOUNCEMENTS

Changes in Nomenclature.—*Indian Farming* (March 1940) makes the important announcement that the improved varieties so far evolved at Pusa and others that may in future be bred at New Delhi will henceforth be known as Imperial Pusa varieties. This change has been made to keep up the earlier association of the Imperial Agricultural Research Institute with the word Pusa and at the same time to distinguish the strains bred by the Imperial Department of Agriculture from those which may be bred by the Bihar Agricultural Department at their station at Pusa. This nomenclature will also be adopted for the milch herd of the Institute as well as for herbarium specimens and specimens of insects, fungi, etc. A list of the old and new names of the varieties of improved varieties of crops under distribution is given, of which the following will serve as examples:—Of wheats, the old names Pusa 4, 12, 52, etc., are now changed to I.P. 4, 12, 52 respectively; of paddy, the old names Pusa Type 9, 18, 24, etc., are changed to I.P. 9, 18, 24 respectively; of linseed the old names Pusa Type 12, 121, 124, etc., are changed to I.P. 12, 121, 124 respectively and so on with the other crops.

The establishment of an **International Collection of Cereal Varieties**, for the study of the physiological races of rusts, has been suggested by Riehm (*Rev. App. Myc.*, 1940, 19, 136). It has been pointed out that plant breeders require to know the reaction of cereal varieties to rusts (*Puccinia* spp.) not only in their own countries but also in neighbouring ones, where different physiologic races of the rusts may exist. Such information may safely be obtained only by field experiments in the countries concerned. The author has put forward proposals for international collaboration in such a project.

We acknowledge with thanks the receipt of the following:—

"Journal of Agricultural Research," Vol. 59, Nos. 10 and 11.

"Agricultural Gazette of New South Wales," Vol. 51, Pt. 4.

"Journal of Royal Society of Arts," Vol. 88, Nos. 4557 and 4558.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 31, No. 3.

"Biochemical Journal," Vol. 34, No. 3.

"Journal of the Institute of Brewing," Vol. 46, No. 4.

"The Journal of Chemical Physics," Vol. 8, No. 3.

"Journal of the Indian Chemical Society," Vol. 17, Nos. 2 and 3.

"Comptes Rendus" (Doklady), Vol. 26, No. 5.

"Indian Forester," Vol. 46, No. 5.

"Transactions of the Faraday Society," Vol. 36, No. 228.

"Indian Farming," Vol. 1, Nos. 3 and 4.

"Genetics," Vol. 25, No. 2.

"Geological, Mining and Metallurgical Society of India," Vol. 10, Nos. 3 and 4.

"University of Illinois Bulletin," Vol. 37, Nos. 11, 12, 13 and 20.

"Journal of Nutrition," Vol. 19, No. 3.

"Proceedings of the Royal Irish Academy," Dublin, Vol. 45, No. 16 and Vol. 46, Nos. 1–3.

"Bulletin of the Health Organisation of the League of Nations," Vol. 8, No. 6.

"Chronicle of the Health Organisation," Vol. 2, No. 3.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 35, Pt. 4.

"Review of Applied Mycology," Vol. 19, No. 3.

"The Mathematics Student," Vol. 7, No. 4.

"The Bulletin of the American Meteorological Society," Vol. 21, Nos. 2 and 3.

"Scripta Mathematica," Vol. 6, No. 3.

"Indian Medical Gazette," Vol. 75, No. 4.

"American Museum of Natural History," Vol. 45, No. 3.

"Nature," Vol. 145, Nos. 3673–76.

"Indian Journal of Physics," Vol. 13, No. 6.

"Canadian Journal of Research," Vol. 18, No. 3.

"Journal of Research" (National Bureau of Standards), Vol. 23, Nos. 2–4.

"Sky," Vol. 4, Nos. 5 and 6.

"Science and Culture," Vol. 5, No. 11.

"Indian Trade Journal," Vol. 137, Nos. 1767 and 1768.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 10, Pt. 1.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

April 1940. SECTION A.—H. J. BHABHA: *Classical theory of spinning particles.*—Dealing with a point dipole with no extension, it is shown that completely relativistic equations free from singularities can be found. R. H. SIDDIQUI: *Strychnine and Brucine—Part III. Some derivatives of dinitrostrychnic acid.*—Tafel's dinitro-strychnine hydrate has been proved to be dinitro-strychnic acid. MATA PRASAD AND K. V. MODAK: *Viscosity of stannic phosphate gels during setting.*—The viscosity changes in the gel-forming mixtures have been studied with time and the effects of temperature and of addition of non-electrolytes to these mixtures have also been studied. N. V. SUBBA RAO AND T. R. SESHADRI: *Some organo-mercury compounds derived from quinine and cinchonine.*—Mercuric chloride forms combinations with the basic nitrogen atoms of the alkaloids whereas with mercuric acetate it is possible to produce compounds by addition at the ethylenic double bond. K. GANAPATHI: *Chemotherapy of bacterial infections—Part II. Synthesis of some sulphanilamide derivatives and the relation of chemical constitution to chemotherapeutic action.*—2-N^1-Sulphanilamido-thiazol appears to possess a very striking effect. Substitution of the amide part of the sulphanilamide especially by a heterocyclic ring, produces compounds of increased activity. N. A. SHASTRY: *On Angelescu's Polynomial* $\pi_n(x)$. H. L. DUBE AND S. PRAKASH: *Kinetics of Sol-Gel Transformation—Part III. The influence of temperature on the setting of some inorganic jellies.* H. L. DUBE: *Kinetics of Sol-Gel transformation—Part IV. The influence of purity of the sol on the setting of ferric arsenate and ferric phosphate jellies.* H. J. BHABHA: *On elementary heavy particles with any integral charge.*—The heavy elementary particles can exist in states of all integral charges, positive, negative or zero, the different states having different rest masses. P. V. KRISHNA IYER: *The analysis of asymmetrical experiments with special reference to the partition of treatment sum of squares.* F. C. AULUCK: *On some theorems of Ramanujam.*

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Meteorological Office Colloquium, Poona:

April 5, 1940.—J. M. SIL: *Schonland's Work on Lightning.*

Entomological Society of India (Bengal Branch):

April 10, 1940.—C. C. GHOSH: *Study of and Work on Entomology in Bengal.*—A general review of the growth of entomology in India. Special stress is laid upon the study of insects under natural conditions, specially of those insects that are of economic importance.

ERRATUM

Vol. 9, No. 3, March 1940:—

Contribution entitled "Asynapsis in Chilli (*Capsicum annuum* L.)", p. 126, para 1, first line: *For* "meotic" *read* "meiotic"; fifth line: *For* "such as" *read* "in". Para 2, line 9: *For* "(Fig. 1)" *read* "(Fig. 2)"; line 11: *For* "(Fig. 2)" *read* "(Fig. 1)". P. 127: It must be noted that Figs. 6, 7 and 8 are reduced to 4/5 and Fig. 9 to ½ the original; p. 128: at the bottom of the note *for* "Imperial *Agriculture* Research" *read* "Imperial *Agricultural* Research".

SUPPLEMENT TO CURRENT SCIENCE

Vol. IX] INDIAN SCIENCE CONGRESS, MADRAS, 1940 [No. 5

Summaries of Addresses of Presidents of Sections

BOTANY

President: PROF. YAJNAVALKYA BHARADWAJA, M.Sc., PH.D., F.L.S.

SOME ASPECTS OF THE STUDY OF MYXOPHYCEÆ

MYXOPHYCEÆ as a group form one of the most primitive groups of plants retaining their evolutionary lag. They are characterised by the possession of the blue green pigment, and the absence of any definite motile bodies, chromatophores, or reproductive organs. They form the chief constituent of planktons or 'water blooms' both of marine and fresh water. For the luxurious development of the plankton, various edaphic factors are responsible, such as light, temperature (upto 18–22°), and chemical substances produced by the decomposition of organic matter and dissolved carbonates of magnesium and calcium.

Many species of Myxophyceæ are present in plankton, and among these are forms like Microcystis, Chroococcus, Coleosphaerium, Spirulina, Ocillatoria, Anabæna, Nostoc, Nodularia, Aphanizomenon, Rivularia and others. In some cases on account of their abundance they give the characteristic hue to the landscape, as *Ocillatoria erythræa*, which is responsible for the red colour of the water in Red Sea. Ph value of water which is influenced by stagnation and other factors, also influences the growth of the algæ.

In ponds where the water is used for domestic purposes, the development of these blue-green algæ is nauseating. It produces nasty odours, and on account of synthesis of various kinds, produces toxic substances, and harbours many kinds of bacteria. Gillam, Fitch and others have shown, that mortality in some of the domestic animals is caused by the use of water containing Cyanophyceæ like *Microcystis flos-aquæ*, *Anabœna flos-aquæ* and others. *Lyngbya majuscula* is said to cause the death of horses feeding upon them. Fishes feed upon many of the algæ growing in ponds. But when there is a thick growth of algæ death of many fishes such as trouts has been reported, on account of oxygen exhaustion in the water during nights. It has been suggested that by the use of copper sulphate, and sodium arsenite in known quantities, the algæ can be effectively controlled without killing the fishes.

Many of the Myxophyceæ are the first plant forms to grow in the soil, and form substrata and manure for the growth of higher plants. Prof. Fritsch demonstrated the fixation of nitrogen by forms like *Anabœna gelatinosa*, and *A. naviculoides*, resulting in the increased fertility of the soil in rice fields.

The demarcation between the various genera and species is very confusing on account of the presence of a number of inter-grading species. Ecological study of the forms must be surely taken into account before classification is studied.

Prof. Bharadwaja gives an account of the structure and development of heterocysts, and also of the various views regarding their nature. They are said to be of the nature of reserve substances, bodies limiting the length of filaments, structure helping in hormogone formation, archaic reproductive bodies, and receptacles for enzyme, responsible for the development of gas vacuoles. Perennation in non-spore forming forms is described. In forms like *Scytonema geitleri*, and *Fischerella anomala* development of hormocysts for perennation occurs.

Cytology of Myxophyceæ is very problematic. The nature of the incipient nucleus is not clearly understood. Mitosis during cell division is absent. The 'Chromidial apparatus', which is the central region in the cell giving reactions to nuclear stains, lacks a well-defined nuclear membrane.

The resemblance between Myxophyceæ and thread bacteria is pointed out. They are grouped under Schizophyta by Cohn. The mucilaginous sheath of Tolypothrix and Cladothrix, and the oscillating movements of Ocillatoria and Beggiatoa are very striking, and point out their close resemblance. But there is no similarity between these organisms, when the structure of the cell wall is considered.

ENTOMOLOGY

President: Dr. Hem Singh Pruthi, M.Sc., Ph.D., F.N.I.

ECOLOGY AND CONTROL OF INSECTS

THE study of organisms in relation to their environment as affecting insect pests of crops, has, of late, assumed an ever-increasing importance. Knowing accurately the conditions of environment of injurious insects, we can investigate the possibilities of changing their whole economy in our favour. In a number of cases, it is now possible to predict their outbreak and thus the cultivators are in an advantageous position, to devise suitable measures for controlling the pests as soon as they appear.

The three classes of elements comprising the environment of insects are (1) Media (water, soil, air), (2) Factors (light, heat, humidity, parasites and predators), (3) Controls (topographic or climatic). Our pests being mostly terrestrial, water, as a medium of environment, has been omitted from the scope of this discourse.

Of the various factors of environment, namely, light, temperature, humidity, rainfall, atmospheric pressure, and air currents, light is the greatest single source of energy for almost all biological systems. Light, as an ecological factor, has been defined as all short wave-lengths of radiant energy, upto and including the visible spectrum. The effect of sunlight and ordinary daylight, on the flight and reproductive activities of various insects of economic importance has been too apparent to need emphasis. Artificial sources of light, too, are continually being made use of in destroying injurious insects all over the world. Certain experiments of Chapman on *Tribolium confusum*, and of Northrop on Drosophila, however, point towards the importance of the influence of light, not being quite conclusive.

One of the fundamental necessities of insects is to maintain a proper balance between the moisture content of their bodies and that of their environment. The distribution and abundance of insects is, therefore, profoundly influenced by the range of humidity present in different regions.

The influence of rainfall, as an ecological factor, is closely related to that of humidity; in fact, the latter is dependent on the former. The abundance of insects as well as the possibility of their control, in a tract, is affected not only by the total amount of rainfall, but also by its distribution in time.

In nature, the effects of temperature and humidity are very much dependent on each other. They vary together and roughly do so reciprocally. The same intensity of heat may affect an insect according to the moisture content of the air which, in itself, depends upon temperature, especially when it is high. It has been found that there is a definite zone of optimum combination of temperature and humidity and that fluctuations of either factors from the optimum are injurious to the insect pests. The best available index for expressing the influence, particularly of temperature and humidity, is the evaporating power of the air, and the saturation deficiency, rather than the relative humidity of the air. Insect behaviour in many cases, is closely correlated with the saturation deficiency of the atmosphere.

Insects are able to endure far greater variation of barometric pressure than are normally found on the surface of the earth, and therefore, atmospheric pressure does not appear to be an ecological factor of much significance. It should, however, be kept in view while evaluating the influence of physical factors on insect activity.

Ecological studies are fully justified, as they help us in forecasting of insect outbreaks, and their relative abundance, as well as in affording us information about the vulnerable points in the bionomics of insects, which can form bases for their practical control. In fact, in ecological or natural methods of control, there appears to be a potential solution of many entomological control problems.

ANTHROPOLOGY

President: Rao Bahadur K. N. Dikshit, M.A., F.R.A.S.B.

SCOPE OF PREHISTORIC AND ANTHROPOLOGICAL WORK IN INDIA

IN his Presidential Address, Rao Bahadur K. N. Dikshit draws attention to the intimate connection of archæology with anthropology; Sir Leonard Woolly has drawn pointed attention to the absence of *sufficient* contact between the Archæological Department and Anthropologists in India and has stressed the necessity for close contact among the workers interested in these two fields of scientific research. A common plan may result in a more intelligent collection of anthropological material, and the task of archæologists will be rendered simpler if the museums were to collect and preserve not only ancient pottery and handiwork, but also those produced by primitive peoples of the present day. For extending the scientific activities in prehistoric archæology and anthropology more workers are required. The need for organising this is very urgent, as the pace of advancing civilization may wipe out ancient ruins and the primitive tribes who are giving up their old ways of living.

Rao Bahadur K. N. Dikshit then refers to the pioneering work of Bruce Foote in the field of prehistoric archæology and the important results obtained by him concerning the sequence of palæolithic and neolithic cultures. He cites the example of the systematic survey made by the Yale-Cambridge Expedition led by Dr. De terra in the Sohan Valley in the North Punjab and the valley of Kashmere and the unfolding of the existence of a palæolithic culture between the Indus and the Dhebu. Mention is made of the most interesting and well-developed phase of prehistoric civilization of India in Harappa

and Mohenjo Daro and the discovery of skeletal material which may throw further light on the racial character of the Indus people. The necessity for research to ascertain the sequence of metallurgical knowledge in India is also pointed out.

The Rao Bahadur then commends the study of megalithic monuments in regions occupied by the primitive tribes from Assam to the Malabar coast and the unlimited scope for work in South India owing to the abundance of material for manufacture of tools suitable for palæolithic and neolithic man. He hopes that the Government of India would implement the recommendation of Sir Leonard Woolly that two protohistorians may be appointed at once to tackle such problems. The need for a Physical Anthropologist on the staff of the Archæological Department is then stressed. He also commends anthropometric work and suggests that the only way in which large-scale measurements can be undertaken would be to make it part of the Census operations and that Universities and learned bodies should undertake the work. Lastly, he invites attention to the collection of anthropological material from ancient records dealt with by Indian Epigraphists and sums up by an appeal for attention being diverted to these long-neglected studies.

ZOOLOGY

President: PROF. B. K. DAS, D.SC. (LOND.)

NATURE AND CAUSES OF EVOLUTION AND ADAPTATION OF THE AIR-BREATHING FISHES

UNTIL quite recently, comparatively very little was known about the habits, structure, development and physiology of a very interesting group of certain curious, amphibious, tropical fishes, mostly confined to fresh water and distributed over distant parts of the world. These fishes have a double mode of respiration owing to the possession of some kind of special adaptational structures known as the accessory air-breathing organs or *lungs* in addition to the gills: they can either normally breathe the oxygen dissolved in the water by means of their gills so long as they are in water, or the atmospheric air directly under certain special circumstances, as when they occasionally leave their natural abode. The adaptation that is most commonly met with amongst the Indian fishes takes the form of certain specialised receptacles or chambers lying above the gills, which are therefore called the suprabranchial air-breathing chambers [*e.g.*, the snake-headed "walking fish" (*Ophicephalidæ*), certain cat-fishes (*Clarias* and *Saccobranchus*), the so-called Climbing Perch of India (or the famous 'Koi' fish of Bengal—*Anabas scandens*), the Cuchia "eel" (*Amphipnous cuchia* = the 'Koon-chey' fish of Bengal), etc.]. Besides, several other extremely interesting adaptations and modifications have been described in the address.

Dr. Das has investigated and given a complete account of the structure, development and physiology of these interesting adaptations in the majority of the Indian air-breathing fishes.

Broadly speaking, all the air-breathing fishes of India are found in practically all kinds of waters, and fall under three main habitat-groups, *viz.*:

I. *The Tropical Fresh-water Group*, including those mostly found in tropical pools, muddy water, swamps, tanks, ponds, ditches, smaller streams, etc. [*e.g.*, *Ophiocephalidæ*; *Clarias*; *Saccobranchus*; *Anabas* (and other *Anabantidæ*); an intestinal-breathing loach called *Lepidocephalus*, etc.] A few in marshes, swamps and muddy banks also (*e.g.*, *Amphipnous* = *semi-terrestrial and most advanced and best evolved air-breather amongst the Indian Teleosts*).

II. *The Tropical Brackish and Estuarine Waters Group*, including the coastal, estuarine and brackish water species (*e.g.*, a brackish water eel, *Pisoodonophis boro* and a Gobiid, *Pseudapocryptes lanceolatus*); others on the shores and mud-flats of these waters, *e.g.*, the "Walking Goby" or Mud-skipper = *Periopthalmus*—a *semi-terrestrial* fish, mostly found on mud-flats, and very cunning in its movements, showing very characteristic twitching movements of the eyes; the supposed breathing by means of the tail region in this fish is an entirely false notion. *Boleophthalmus* skims over the surface of water very rapidly in a serpentine manner.

III. *The Tropical Marine Group*, including the "Rock-skipper" (*Andamia heteroptera*—a Blenniid, which lives on rocks beyond the surf line), and a few other coastal Blenniids and some other coastal fishes also.

In all, *as a result of response to the direct effects of environment*, chiefly due to the lack of oxygen in the surrounding medium, Dr. Das has described six main types of these beautiful structural adaptations or "lungs" which have evolved in the different groups of fishes, which are, as a rule, distantly related to one another. This series of adaptations illustrates one of the finest examples of what is known as "parallelism in Evolution".

Starting from a simple and most primitive vascularised bucco-pharyngeal epithelial surface for aerial respiration, Dr. Das has carefully traced the successive stages in the evolutionary adaptational modifications leading to complicated air-breathing structures, involving corresponding alterations in the gills and the alimentary canal and in the vascular system. This section forms the most important part of his investigations covering an extensive field of enquiry and patient work.

From his studies Dr. Das concludes that the accessory respiratory organs in fishes are chiefly concerned with oxygen absorption, whereas the gills are the principal organs for the excretion of CO_2 (except *Hypopomus* and probably *Symbranchus*, where the gills also partly subserve aerial respiration in addition to their normal function of aquatic respiration).

MEDICAL AND VETERINARY RESEARCH

President: Dr. J. P. Haddow, B.Sc., M.R.C.V.S., D.V.S.M.

THE DEVELOPMENT OF ANIMAL HUSBANDRY IN INDIA

OWING to the varied climatic and geographical conditions in India, a wide range of animals, such as, elephants, camels, horses, cattle, buffaloes, sheep and goats came under man's domestication. In the maintenance of these varied species as well as their development, various factors have played a great part from time to time, the foremost among them being the problems of famine and disease. The presence or absence of disease or famine have been the main, if not the exclusive, controlling forces in the development of Animal Husbandry in this country. This also explains why, in matters of live-stock, quality was being subordinated to quantity in this country, the numbers serving as the only effective insurance for the husbandman against the ravages of animal diseases caused by several agencies, *e.g.*, Viruses, Bacteria, Protozoa and Parasites.

The means for the prevention of any disease must have a cash value commensurate with the value of the animal protected and must, therefore, in the beginning be exceedingly small. The so-called Serum simultaneous method of inoculation, for instance, against Rinderpest, although indisputable in its efficacy, had not been of much success as it costed a rupee or more per head. This problem was solved, thanks to the endeavours of Dr. Edwards, fifteen years ago by the evolution of a cheaper method of vaccinating cattle with a strain of virus fixed in goats. Difficulties in the progress of control of other virus diseases, *viz.*, foot and mouth disease of cattle, pox of animals and poultry, Ranikhet disease of poultry, etc., could, with the exception of foot and mouth disease, largely be attributed to the lack of accurate diagnosis and want of suitable specific methods of controlling them. Till recently the extent to which virus infections might be responsible for wastage had not been fully realised.

Under Bacterial diseases, the greatest damage was caused by Pasteurelloses. The use of antiserum and a vaccine for the control of actual outbreaks of these had been reported to be uniformly successful with, perhaps, a few exceptions. Further important developments might accrue from careful research into the factors controlling the distribution and the incidence of these conditions. More precise information is also necessary on the epizootology of Anthrax and Black-quarter, if full advantage is to be taken of the remedial measures available. Organised measures for the diagnosis and control on a large scale in India have yet to be made, on diseases like Contagious abortion, Tuberculosis, Tchne's disease, etc.

Of the Protozoal diseases, Piroplasmosis of cattle and Trypanosomiasis of horses and camels and Spirochætosis of fowls stand out prominent. These could not be properly considered without reference to their insect vectors, and in all these cases the eradication of the vector rather than the control of the parasite must be the objective. Suitable measures are known for the reduction of wastage due to parasitism such as that carried on by Warble fly larvae, Tick infestation and depradation of biting flies.

Proceeding to the second main factor, namely, famine, the problem was now slowly changing from one of total famine to several of partial famines, particularly of "Individual essential ingredients in the diet". Malnutrition was evident everywhere and it was gratifying to note that the danger had been realised and necessary steps were now being taken. The provision of well-balanced supplies of food represents a real economy, not only because of increased production but also by increasing the resistance to disease and parasitic infestation.

As time advanced, interest in quality rather than the quantity of stock was bound to become more general. The development from this point onwards depended upon our increasing knowledge of the science of Genetics. At one end of the scale was milk and at the other end draught. Whether it was possible to combine milk production with the capacity for fast work remained to be seen. On the side of milk production the development of the buffalo had to be considered. In the case of the sheep the objectives must be first to investigate the possibility of wool, mutton and transport separately before attempting to combine them indiscriminately. While the goat could exist and produce "a modicum of milk" where the cow would starve, there was the question of damage caused to the shrubs to be considered and, if allowed unrestricted range, this species might become a nuisance to those engaged in fighting soil erosion. Finally the education of the husbandman himself should not be overlooked. "As with his animals, so he himself must have a fair insurance against famine and disease if he is to take an active part in the development of the industry which he controls".

P. M. N.

AGRICULTURE

President: Prof. Jai Chand Luthra, M.Sc., D.I.C., I.A.S.

SOME PROBLEMS OF CROP PRODUCTION IN INDIA

THE main theme of the President's Address of the Session is the importance of seed as a factor in crop production, though among other problems of a somewhat familiar character, both scientific and economic, are also dealt with. The indifference of the farmer to the importance of seed is one of the chief causes responsible for the set-back to agriculture, notwithstanding the existence of the general belief in good seed as evidenced by the practice of prudent farmers everywhere and of proverbs current inculcating the value of such seed. Work in India on the different aspects of the problem is reviewed. Viability trials by [illegible] of one to ten-year old seeds of sixteen different

crops, by Labh Singh of vegetable seeds, by Nadi and Ganguli of rice and of the relation of catalase to viability, and work on the relation of depth of planting to germination by Singh and Alamare are noticed among others. Luthra and Chima's experiments to show that plumpness in grain is no advantage over shrivelled grain and that there is no advantage in grading wheat for size for seed purposes are mentioned, though this is contrary to general belief. Poor germination as the result of a thick seed-coat is referred to and the well-known methods of abrading, softening and other treatment by which this can be got over are described —methods which, in practice, can result in a great saving in the seed grain. Lyallpur experiments with Berseem bring out the usefulness of colour as an indication of viability, and of heavy fodder-yielding capacity. Purity in grain as affecting not only its market price but also the yield and quality of produce is referred to and the great prevalence of ear-cockle in wheat in the Punjab is mentioned as a serious trouble; it has, however, been shown to be easy of avoiding by the careful winnowing out of the galls. Loss of seed in the field after sowing which necessitates the use of heavy seed rates where much smaller rates can be used with advantage and the need for preventing such loss are brought out by certain Lyallpur experiments on the yield from varying seed rates of wheat. Vernalisation affords some scope in the acclimatization of promising exotic plants and varieties; distinct earliness was induced in sorghum and in mustard, in experiments conducted so far in Rohtak and Almora. Quality in seed or other produce as affected by manuring is dealt with, and the work of Viswanath on the effect of organic manures in enhancing the nutrient value of certain food grains, and the work in the Punjab and elsewhere on the influence of climatic and soil factors on the nutritive value of grass, especially in raising the protein, calcium and phosphatic contents are summarised. In superior varieties like improved types of cotton or wheat, the value of the higher quality is often offset by low yields; these consequently have to be raised by enabling the farmer to use larger quantities of manure and fertilisers. The work on the malting of food grains in Bangalore and in Coimbatore of ragi and sorghum respectively opens out a more remunerative use for produce; it is suggested that work should be started to see if many of the imported food preparations cannot be made out of local produce.

Arising directly out of the main theme of the address, a strong plea is put forward for the establishment by Government, of seed testing stations, where commercial seed can be examined and certified not merely for germination but for the several other requirements of good seed. The expenditure of more money on research and expansion and the formation of a committee of the Science Congress as an unofficial *liaison* agency between the public and the Government in respect of these problems of agricultural improvement, are other suggestions made.

A. K. Y.

PHYSIOLOGY

President: Dr. W. R. Aykroyd, M.D., Sc.D.

RICE

Rice is the staple food of about half the human race. In India the area under rice exceeds that under all other cereals put together. A poor rice eater in India consumes in addition to his staple cereal, which provides 80–90 per cent. of calories, only very small quantities of other foods such as pulses, vegetables, fruits and meat. Milk and milk products are taken in negligible quantities or not at all. Hence the nutritive value of the main ingredient in the diet is of great importance.

Rice is a poor source of fat, vitamin A, certain vitamins of the B_2 group and calcium. Its protein content is low compared with that of the other cereals but the biological value of its protein is comparatively high. Milled rice is poorer than under-milled rice in most important constituents. Parboiled rice, even when highly milled retains most of the anti-beriberi vitamin B_1 originally present in the unmilled grain. This is due to the fact that vitamin B_1 and other valuable food factors present in the outer layers diffuse into the grain during the process of parboiling and they escape removal when milling subsequently takes place. Washing of any kind of rice removes about 50 per cent. of vitamin B_1 and nicotinic acid.

The main reason why Beriberi is endemic only in the Northern Circars of the Madras Presidency is due to the fact that raw milled rice is consumed in these parts unlike parboiled rice in other parts.

Hand-pounded rice is superior to milled rice but the difference between the two is small when it is parboiled. The prevention of the spread of mills into areas where hand-pounded rice is still being used can be checked by legislation. The use of hand-pounded, or under-milled or parboiled rice may be encouraged by education and propaganda.

Milk and milk products can usefully supplement a rice diet and therefore every effort should be made to increase milk production. Partial substitution of rice by ragi (*Eleucine coracana*) improves poor rice diet. Special attention must be given to the increased production of green leafy vegetables which are rich in vitamin A and calcium. The fishing industry needs greater development with a view to providing fish liver oils, rich in vitamin A and D.

The state of nutrition of children who cannot afford milk can be improved by the administration of calcium-lactate.

PSYCHOLOGY

President: Dr. D. D. Shendarkar, Ph.D.

PSYCHOLOGY AND EDUCATIONAL RESEARCH

After tracing briefly the growth of "Psychology in India", and emphasizing the importance of Psychology in Educational Research, Dr. Shendarkar observes that mere systematisation

or systematic study of psychological facts and theories and their scientific presentation would not be enough and that "a functional approach" should be recommended so that "the course in psychology be built round vital school issues and educational problems". Dr. Shendarkar complains that experiments have been worked out in psychological laboratories and that they have "little relation to learning in the school-room". The basic problem in Education is Learning. He then refers to the familiar "Mental Tests", "Examinations and Scholastic Tests", and examines how far Psychology can offer "vocational and educational guidance". In the concluding portion, Dr. Shendarkar refers to the importance of child-study and child-psychology, and remarks that undesirable habits like "thumb-sucking, nail-biting, ... nervousness, temper-tantrums, lying, stealing," etc., may be effectively eradicated if the Social Worker, the Psychologist, and the Psychiatrist combine their efforts. Dr. Shendarkar concludes with an expression of his feeling that "utilitarian study of Science, more especially psychology, has not kept pace with its academic study and what our country needs at the present juncture is applied knowledge more than pure science". It should be noted that Dr. Shendarkar wants a Central Institute of Education on the model of the Institute of Science at Bangalore, and that the office of the Commissioner for Education, Delhi, would be the most "suitable nucleus for such an institute".

A Central Psychology Institute like the one advocated by Dr. Shendarkar may find temporary or permanent employment to some now peradventure unemployed, and it is doubtful if such an Institute would make any original or substantial contributions to Pure and Applied Psychology. I do not believe that things move on in the Western Civilized Countries strictly after the application of the Psychological Intelligence tests or group-tests. Recruitment to Army, Navy, Air-Force, and the Public Services is made on various considerations, and it must be an extraordinarily rash assertion to make that such recruitment is governed by the verdict of the Experimental Psychologist, the Physical Institute, etc. That being so in the West, the land of Experimental Psychology *par excellence*, its cultivation on the Indian soil requires serious thinking.

Nor am I convinced about the validity of Dr. Shendarkar's advocacy of "applied knowledge at the present juncture more than pure science". For, application or no application, Pure Sciences must progress. That is the true spirit of Research. I would demand of any scientist to tell the average unsophisticated man what have been *actually the practical applications* of the Raman-Effect, and Sir C. V. Raman's researches in normal and abnormal scattering of light, and what applications are likely to be made in the near future. Looking at it psychologically, it is all a matter of special aptitude. Even in the land of its birth, the land of the Almighty Dollar, Behaviourism (old and new) is not exactly harnessed to practical American politics. Leaders of men, war-mongers, peace-makers, commercial magnates are not *conditioned into being or existence* by the practical applications of the principles of Behaviourism which is still a Pure Science. Untrammelled development of Psychology as a Pure Science is the first concern. It would then be time enough to develop Applied Psychology.

R. NAGARAJA SARMA.

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FEEDING THE PEOPLE IN WAR-TIME

NAPOLEON had a gift for witty and penetrating comment which the contemporary aspirant to the position of world conqueror, Adolf Hitler, lacks. Napoleon said "An army marches on its stomach". In modern war not only the army but the whole nation is concerned, and Napoleon's saying may be given a wider significance. An ill-fed and starving people has no stomach for the fight and will inevitably be defeated. The mistaken food policy followed in Germany during the War of 1914–18 was a major factor in bringing about the victory of the Allies. In the Spanish civil war the people of Barcelona, who had survived brutal air raids without serious impairment of morale, lost their fighting spirit after long months of semi-starvation.

The proper feeding of civilians, Orr and Lubbock* remark, is a more difficult problem than the feeding of the Army and Navy. In their recent book they define a national food policy for the import, production and distribution of food which is based on the principles of nutritional science and knowledge of the existing dietary habits of the people. The tedious diet survey work which has been carried out within recent years here proves of the utmost value. At the same time, the potentialities and limitations of British agriculture are fully understood and allowance is made for the restriction of imports which has already occurred and which must become more serious as the war proceeds. Very briefly outlined, the proposed policy is as follows: The fundamental object is to provide the entire population with a diet which will maintain its health and physical efficiency. Even in peace time a very considerable proportion of the population consumes a deficient diet and in war-time this diet is likely to deteriorate further with the rise in food prices. The fulfilling

* "Feeding the People in War-time" by Sir John Orr and David Lubbock. (MacMillan & Co., Ltd., London), 1940, Pp. 88, Price 1*s.* 6*d.*

of the needs of this group, "the weakest part of the home front", should be made the cardinal aim of the nation's food policy. "If they are well fed we need not worry about the rest of the population."

The subsidising of certain basic foods is recommended. The Government has already made an annual allotment of 50 million pounds for subsidising foods. Orr and Lubbock suggest that bread, milk and potatoes should be subsidised. The potato is the best insurance crop against food shortage. The wholesale price of these foods should be fixed by subsidy at a level which would enable the poorest families to obtain sufficient for their needs. Wholesale and not retail prices should be fixed. The small retailer has little opportunity for extensive profiteering.

The organisation of agricultural production on the right lines is of essential importance. There are 4 million acres of good land available in Great Britain which can be brought under cultivation, whereas in Germany production has probably already reached its maximum. But at present the farmer, urged to develop his land to the fullest possible extent, does not know what to produce; "the agricultural policy, as far as it is known, is too vague to call forth the additional foods we need". But production can be regulated by price in the same way as consumption. If there is a guaranteed minimum price and a guaranteed market for certain foods the farmer will automatically produce them. There is little difficulty about a guaranteed market since the Government is already the wholesale purchaser of many foods and no doubt by the end of the war will be in complete control of all the wholesale food trade. This system, the authors think, would utilise the land to better advantage than a system of compulsory ploughing up without any guidance as to what additional foods should be grown.

A very large increase in the production of vegetables other than potatoes is both possible and desirable. Not only farm land, but also gardens and allotments, should be utilised to the fullest extent. "If the campaign for increased vegetable growing in gardens and allotments were pushed hard enough it might be possible to have nearly half of the families in the country self-supporting in vegetables."

Import and agricultural policy must be closely co-ordinated. Normally Great Britain imports some 70 per cent. of its total food supply, so that a satisfactory plan for regulating imports is in a sense more important than the planning of agriculture. One of the guiding principles should be that imports which provide a maximum of food value for a minimum of shipping space should receive priority. This means bread and fats, which should be given priority "until we have a store which puts us beyond the danger of shortage". Sugar is a concentrated food, but since it is a pure carbohydrate and contains no protein, vitamins and minerals, has a smaller claim to priority. It is not sensible to import bacon, beef or eggs in large quantities; these foods take up relatively more shipping space per 1000 calories, and can to a reasonable extent be produced at home. Nor is it economical to import fodder crops because it takes 5–20 tons of feeding stuff to produce one ton of human food. Food for livestock, consisting mainly of grass, grass silage, and, to a lesser

extent, of fodder crops, must as far as possible be produced within the country itself. The dairy cow and pig are more efficient and economical converters of feeding material into human food than poultry or beef cattle. There are large areas of rough grazing suitable for sheep.

The authors deal with the question of rationing. The purpose of rations is to ensure that each person gets the same amount and to prevent food hoarding. But actually about one-third of the population cannot afford to purchase the amounts of bacon and butter allowed by the rationing scheme already in force, and those who have the money cannot obtain their usual supply without underground trade in coupons. It follows that if the supplies necessary to provide the whole population with the given ration are made available, there will be considerable wastage. Rationing systems have many disadvantages. They do not necessarily ensure the equable distribution of food for the above reason, and they limit choice of food, which is physiologically undesirable. It is hoped that bread, milk and potatoes will be available in such abundant quantities that their rationing will be unnecessary. Food-hoarding is not likely to be a serious problem.

The authors claim that, if their food policy could be put into successful operation, the nation would be provided with a diet which, while considerably less rich and varied than its customary diet, would nevertheless be an adequate and well-balanced one. To deal with the problem in all its aspects, a small "Food Council" should be appointed. It appears that at present no clear-cut policy is being followed. "The lack of co-ordination between the Ministries of Food, Agriculture and Health is causing a certain amount of disquiet."

It is impossible in a brief article to deal with the questions raised in this book, which illuminates one vitally important department of war activity. Reports of recent parliamentary debates show that its lessons have not been lost on politicians. Mr. Lloyd George, in particular, appears to have been impressed by its conclusions. No doubt the scheme is open to criticism at certain points and would need to be modified in various respects as the result of war necessity and experience. However this may be, a comprehensive long-term policy is obviously needed to replace piece-meal temporary measures for dealing with the situation.

W. R. AYKROYD.

[*Note added in proof.*—This review was written early in May before the German attack in the West. The events which have taken place since that time make the problem of maintaining the food supplies of Great Britain more urgent and difficult. But as long as American and Canadian wheat can be imported in sufficient quantities to supplement home-grown food there should be no serious danger of food shortage. The potato crop is of essential importance. The lack of cod-liver oil, which is of such high value in preventing malnutrition and rickets in children, can be made good by a synthetic substitute in the shape of a vegetable oil containing concentrates of vitamins A and D.—*Coonoor, June* 18, 1940.]

SHARE OF UNIVERSITIES IN THE DEVELOPMENT OF APPLIED ENTOMOLOGY*

BY

PROF. B. K. DAS

(Osmania University, Hyderabad)

INSECTS form a very vast proportion of the whole animal population of the world, over 60 per cent., *i.e.*, about 625,000 known species; and hardly any other group of animals can compare with them in numbers, except perhaps the Fishes. Considered from the economic point of view they also constitute one of the most important groups in the animal kingdom, especially when we begin to realise what an immense amount of damage is caused to our crops every year by predatory insects.

Of all problems connected with Applied Entomology none is so acute and important as the question of the insect pests, the most important functions of Applied Entomology being the control of insect pests; and it is the farmer that feels the pinch much more than the man in the street. This is better understood, when, for a moment, we just begin to realise the fact that *there is an annual loss of about 200 million rupees in connection with some of the important crops of our country, viz.*, rice, wheat, cotton, sugarcane and oil-seeds. In the U.S.A., on the other hand, where agricultural science and methods are definitely more scientifically advanced, the Insect Pest Survey of the U.S.A. Department of Agriculture reports that the total estimated loss due to insects attacking staple crops, vegetables, fruits, nursery and green-house products, stored products, live-stock, etc., comes to over a thousand million dollars. The U.S.A. Board of Entomology estimates the annual loss from one pest, *viz.*, the *cotton boll weevil* alone, at two hundred million dollars! From these cursory remarks it is quite evident that the study of Applied Entomology is of immense practical importance for the welfare of man.

There are several kinds of insect pests, *viz.*, grasshoppers, caterpillars, active plant bugs, plant lice, thrips, scales and meal bugs, beetles (such as chafers, weevils flea beetles, longicorn beetles, etc.), an borers of many sorts. Besides, there are few others also such as certain plant lice thrips, etc., which act as vectors of certai infectious or *virus diseases* of plants; a these are intimately connected with th agriculture of our country, and hence wit Applied Entomology. Then there are certai problems which may be said to be of Al India importance, *viz.*, (*a*) the periodic visit of certain class of insects, say, tl locusts (*e.g.*, the outbreak of the dese locust—*Schistocera gregaria*, during 192 31), (*b*) the cotton bollworm pests (*vi.* both the pink as well as the spotted varieties and (*c*) the sugarcane pests (*viz.*, tl borers, leaf hoppers, etc.).

It is by proper encouragement and inte sive and extensive research work carried o in the field of applied entomology th a proper control and solution of these ev can be made available. In India, duri past years, farmers used to depend larg on fatalism, faith and certain magic rites f combating insect pests; but during rec times, due largely to the establishment a activities of the central and provinc research agricultural departments, m scientific methods for controlling insect pe are being adopted. The basis of control a correct knowledge of the life-histories a behaviour, including factors such as pho tropism of the injurious insects, gained fi by continuous field-observations and inves gations. A body of well-tested knowle derived from laboratory and field researc carefully devised and successfully purs ought to furnish the entomologists with necessary means for advising the agricult ists and governments regarding the measu to be adopted for combating the ins nuisance.

Unfortunately, in our country, in spite its immense importance and very wide pr tical application, applied entomology has received the proper amount of attention t it should have received in our Ind

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* In writing up this paper the author has derived immense help from the Presidential Address on "Insects and their rôle in Indian Agriculture" delivered by Rao Saheb Dr. T. V. Ramakrishna Ayyar, before the Agricultural Section of the *Indian Science Congress*, Lahore, 1939.

universities. I must observe that the subject of *Entomology* in its applied branches has been neglected in the curriculum of studies in our universities. I take this opportunity of making the following suggestions for the consideration of our universities in developing this most useful branch of Applied Biology:

(*a*) While experts at the central and provincial research institutes and museums are mostly engaged in the systematic, ecological and bioclimatic studies, statistics and other data, the universities can and should devote themselves to intensive and extensive morphological, histological, embryological and physiological studies, and work side by side, in the fullest of co-operation, with taxonomists. Efforts thus co-ordinated would certainly develop the whole study of the most intricate insect-problems of a vast country like ours.

(*b*) The problem of insect pests control being undoubtedly of All-India national importance, the universities should develop a true spirit of teamwork, tackle any pressing problem of an economic nature that is brought to their notice, and work in conjunction with the different research institutes distributed over various parts of India. In this direction the universities can certainly do a lot of useful work on a well-organised scientific basis.

(*c*) In view of the growing importance and potentialities of great usefulness of service that Applied Entomology can possibly render to mankind, this extremely useful subject should be encouraged in every Indian university, where there is a provision for zoological teaching.

(*d*) I should strongly urge that either at the honours stage, or more suitably, at the post-graduate stage, along with the teaching of general zoology, there should be a compulsory special paper on Applied Entomology, or better, say Geneal Entomology, mainly covering its most essential and fundamental aspects. But it is very necessary that properly trained entomologists should be made responsible for this training. It is in this way that our universities can, directly or indirectly, help in ameliorating the sufferings of a vast population of India.

A SOIL MAP OF INDIA

A SOIL MAP OF INDIA based on agricultural and colour nomenclature has been prepared by the Imperial Agricultural Research Institute, New Delhi. The map classifies the soils of India into eight main prevalent categories, (1) alluvial, (2) coarse alluvial, (3) red soils lying on metamorphic rocks, (4) laterite soils, (5) black soils, (6) deep black soils, (7) light soils on trap rocks and (8) deep black alluvial soils. The alluvial soils of extra-peninsular India are further divided into Indus alluvial, Gangetic alluvial and Brahmaputra alluvial soils.

Another map based on climatic differences, and a third, which plots the relative nitrifying efficiencies of surface soils, were also prepared in the Institute. The latter shows a clearly demarcated central belt, running north-east to south-west across the country at the boundary which divides peninsular and extra-peninsular India.

The soils of India offer a distinct contrast to those of many other countries, inasmuch as, they are very old, fully matured and do not show, in many cases, pedogenic processes and the close relationship between the soil and its rocky substratum. The weathered materials in most cases have been transported to great distances by various agencies. An examination of the soils also shows that, although the nature and composition reflect to some extent the composition of the original rocks from which they are derived, the main trend of weathering and its final result are influenced to a considerable extent by the climatic complex, particularly by the amount and seasonal distribution of rainfall. In India the unique monsoonic division of the year into dry and wet periods and the high temperatures that prevail considerably influence the character and sub-aerial denudations of the surface of the country.

THE CHEMISTRY OF PLANT RESPIRATION

BY

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SINCE the brilliant discovery by Keilin, of the role of cytochrome in cellular respiration, and the consequent reconciliation of the diverse views of Wieland and Warburg on hydrogen and oxygen activation in biological oxidation, rapid advances have been made. The concept that cytochrome was the only carrier between oxidase and dehydrogenase action proved too simple a hypothesis; and now, thanks to the work of Warburg, von Euler, and the Cambridge school, the flavoproteins and coenzymes I and II (phosphopyridine nucleotides) are known to assist in the transfer of hydrogen from substrate to oxygen. The path of H-transfer is represented diagrammatically as follows:—

$$\text{Substrate} \rightarrow \text{coenzyme I or II} \rightarrow \underset{\text{(diaphorase)}}{\text{flavin}} \rightarrow \text{cytochrome} \rightarrow O_2.$$

Side by side with this work, the complex path of carbohydrate breakdown in alcoholic fermentation has been investigated and the subject has recently been reviewed by Meyerhof[1].

Under anærobic conditions, two of the intermediary products of carbohydrate breakdown, acetaldehyde and pyruvic acid, may function as H-acceptors, with the consequent formation of alcohol or lactic acid. In the presence of oxygen, other hydrogen acceptors such as the oxidised forms of the pyridine nucleotides are available, and further oxidation of acetaldehyde and pyruvic acid may take place, resulting in the formation of a series of C_4-dicarboxylic acids, and possibly, of citric acid and related compounds. Decarboxylation of keto-acids in this series results in a continuous evolution of CO_2 and the regeneration of one of the earlier members of the cycle.

The initial stages of carbohydrate breakdown, which include phosphorylation to hexose diphosphate, glycolysis with production of triose-monophosphates, oxidation of the latter to phosphopyruvic acid, and subsequent dephosphorylation to pyruvic acid, seem to be common to both ærobic and anærobic processes. The fact that anærobic fermentation, with production of both alcohol and CO_2, has been frequently demonstrated in the higher plants is therefore strong evidence in favour of the view that the path of carbohydrate breakdown in higher plants follows a similar course to that established for yeast.

It is unlikely that in all plants carbohydrate breakdown will take place in exactly the same way. A general similarity may be expected but not complete identity. In the case of the succulents there is an accumulation of organic acids, so that relatively little CO_2 is produced, although much glucose has been metabolised. Similarly, actively growing tissue probably makes use of considerable quantities of the keto-acids in amino-acid synthesis. This interrelation of respiration with protein metabolism deserves further study.

The analogy between anærobic fermentation in the higher plants and in yeast is strengthened by the demonstration of both the Pasteur and Lundsgaard effects. Marsh and Goddard,[2] and later James and Hora,[3] working with carrot and barley respectively, have demonstrated that under conditions of anærobiosis, more sugar is decomposed per unit time, than under conditions of normal respiration (Pasteur effect). Turner[4] has shown that under certain conditions, weak solutions of iodoacetate, while inhibiting anærobic fermentatoin in the carrot root, have relatively little effect on its respiration (Lundsgaard effect).

The fundamental similarity between the paths of carbohydrate breakdown in yeast and animal tissues on the one hand, and in plant tissues on the other, has been very neatly shown by James and Arney.[5] These workers established a highly significant correlation between the concentration of phosphate esters and the rate of respiration in young barley seedlings, so long as this rate was not limited by the supply of carbohydrate. Their results showed that phosphate esters play similar roles in respiration in both plant and animal tissues. It was impossible to identify with certainty the

labile and resistant esters of James and Arney with adenosine and hexose phosphates, but the analogy is sufficiently striking to establish the essential similarity of the two phenomena.

James and Norval[6] have demonstrated further similarities in the path of carbohydrate breakdown in yeast and barley leaves, by establishing the presence in barley leaves of an enzyme catalysing the decarboxylation of pyruvic acid.

Turning towards the mechanism by which the oxidative stages in carbohydrate breakdown are achieved, we find a further similarity between plant and animal tissues. Both oxidases and dehydrogenases are found to be essential for these oxidations, and in addition cozymase, and flavins, including diaphorase, have frequently been detected in plant tissues. In many cases cytochrome oxidase itself is present in plant tissues (Keilin,[7] Hill and Bhagvat[8]) while other workers (Marsh and Goddard,[2] Roberts[9]) have shown its presence to be likely in carrot and tea leaf.

Tannins may also play a part in the transfer of hydrogen from substrate to oxygen. In finely minced tea leaf tissue, and in other tanniferous leaves (unpublished observations of the author), tannin functions as a carrier in the oxidative stages of carbohydrate breakdown. In such tissues the path of hydrogen transfer may be written down as follows:—

$$\begin{array}{ccccccc} \text{Substrate} & \rightarrow & \text{tannin} & \rightarrow & \text{cytochrome} & \rightarrow & O_2 \\ & \searrow & & \nearrow & & \nearrow & \\ & & \text{coenzyme I or II} & \rightarrow & \text{flavin} & & \end{array}$$

It is impossible to say at the moment how far tannins play this part in normal plant respiration, but in the damaged plant tissue the normal path of hydrogen transport has been largely put out of action, and practically all the hydrogen transfer takes place through the tannin.

The *o*-quinones of tannins, although quite efficient hydrogen acceptors, have also the property of condensing to form deeply coloured products. In completely organised tissues the reducing powers of dehydrogenase + coenzyme systems is sufficient to ensure reduction of the *o*-quinones before any condensation takes place. With dispersal of coenzymes on damage however, the rate of *o*-quinone formation exceeds the rate at which it is reduced again and irreversible condensation of tannins, and hence pigmentation results. It is suggested that the above mechanism accounts for the well-known darkening of many plant tissues on injury.

The cytochrome system is not the only oxidase that has been established to be responsible for the primary uptake of oxygen in respiration. Considerable attention has been paid lately to the isolation by Kubowitz[10] and Keilin and Mann[11] of very pure catechol oxidase as a copper-protein complex. This oxidase, together with a catechol as carrier, forms a completely analogous system to cytochrome *plus* its oxidase, and Kubowitz has constructed an artificial system consisting of catechol oxidase from potato, catechol, dihydrophosphopyridine nucleotide, hexose monophosphate dehydrogenase, and hexose monophosphate, in which the oxidation processes closely resemble those of cellular respiration.

Other oxidase systems have been demonstrated in plants, of which ascorbic acid oxidase (Huszák[12]), and dihydroxymaleic oxidase (Banga and Szent-Györgyi[13]) deserve mention. Swedin and Theorell[14] have recently brought forward evidence to show that this latter enzyme is identical with peroxidase so that further work in this direction may lead to considerable clarification of our ideas on the role of peroxidase in plant-tissues.

1 Meyerhof, *Nature*, 1938, **141**, 855.

2 Marsh and Goddard, *Amer. J. Bot.*, 1939, **26**, 724, 767.

3 James and Hora, *Ann. Bot.*, (N.S.), 1940, **4**, 107.

4 Turner, *New Phytol.*, 1938, **37**, 289.

5 James and Arney, *ibid.*, 1939, **38**, 340.

6 James and Norval, *ibid.*, 1938, **37**, 455.

7 Keilin, *Proc. Roy. Soc.*, *B*, 1925, **98**, 312.

8 Hill and Bhagvat, *Nature*, 1939, **143**, 726.

9 Roberts, *Biochem. J.* (in the press).

10 Kubowitz, *Biochem. Z.*, 1937, **292**, 221.

11 Keilin and Mann, *Proc. Roy. Soc.*, *B*, 1938, **125**, 187.

12 Huszák, *Hoppe-Seyl. Z.*, 1937, **247**, 239.

13 Banga and Szent-Györgyi, *ibid.*, 1938, **255**, 7.

14 Swedin and Theorell, *Nature*, 1940, **145**, 7

LETTERS TO THE EDITOR

Superconductivity: An Explanation

VARIOUS metals when cooled below a certain very low temperature (characteristic of the metal) show the property of conducting electricity without offering any appreciable resistance to the current. Meissner and Ochsenfeld found in 1933 that a supraconductor behaves not only like an ideal conductor, but also like a very strongly diamagnetic metal. No headway at all has been made in understanding the mechanism of superconductivity. The most promising line of attack is a purely formal theory by F. and H. London.[1] The object of this note is to present a physical picture of the process that is likely to be followed during the transition to the superconducting state.

We suppose that at a temperature depending on the nature of the substance and its crystalline form, the interaction between the lattice and the conductivity electrons becomes so small that it can be neglected. The interaction represents the effect of the electrostatic field of the substance on both the charge of the electron and its spin. In other words, we assume that the interaction between the lattice and the conductivity electrons is small at low temperatures. The amount of interaction depends on the temperature and the magnetic field and it becomes practically zero when the lattice vibrations have reached a critical temperatur which corresponds to the transition temperatu for the superconducting state. Here the co ductivity electrons can be treated as relative free electrons. The motion of each of the electrons will be represented by a de Brog wave and if they are perfectly free there w be no interaction which will give rise to t scattering of two de Broglie waves. The co ductivity will then be infinite and the substan will behave like a supraconductor.

These free electrons will precess in a magne field and give the substance a diamagnetic s ceptibility. When the field strength is increas so that $H > H_c$ the electrons will arrange the selves with their spins parallel to the field a the energy of magnetisation $2H\mu$ is transfer to the lattice (or the interaction between t lattice and the electrons is restored) and t substance is no longer superconducting. Un these conditions the electrons also do not p cess and consequently will not show any d magnetic susceptibility. The effect of incre ing the temperature is thus the same as creasing the strength of the magnetic fi namely, to increase the coupling between lattice vibrations and the conductivity electr When the electrons are free the substance i supraconductor, and the electrons also show

diamagnetic susceptibility as they can precess if they are free to move. Thus the two properties, the superconductivity and the diamagnetic susceptibility go hand in hand.

The value of the diamagnetic susceptibility will be of the order $1/4\pi$, (as observed for the supraconducting state) if we can assume[2] that the conductivity electrons are free to move over a distance which is about 100 atomic distances. This distance is of the order of the mean free path of the conductivity electrons in a metal at ordinary temperatures. At ordinary temperatures the oscillations of the lattice are far from being negligible, and even then the mean free path of the electrons is of the order of a few hundred Ångstrom units. It is therefore reasonable to suppose that the mean free path of the conductivity electrons is of the order of 100 atomic distances when the lattice oscillations play an insignificant role.

If the electrons are completely free there will be no scattering of the de Broglie waves and the conductivity would be infinite. The conductivity in the superconducting state although very large, is probably not infinite. For this purpose an extremely small interaction will have to be introduced either between the lattice which does not now execute temperature oscillations or between the nuclei which are fixed in the lattice and the conductivity electrons. Such a small, second order interaction really exists and is observed for a number of substances in the form of hyperfine structure of spectral lines. This interaction between the nuclear spins and the electron spins, which gives rise to the hyperfine structure is observed for supraconducting as well as for nonsupraconducting substances and is very small. In the supraconducting state this small second order interaction assumes a leading part because it is no longer masked by the otherwise dominating lattice-electron interaction. In the superconducting state, the electrons are free to move over about 100 atomic distances; and we may be required to consider the resultant effect of a large number of nuclear spin interactions. This fact may give us the limiting size of the aggregate of atoms which will just be large enough to show superconductivity.

On this assumption substances which have no conductivity electrons and substances in which the interaction between the conductivity electrons and the lattice vibrations is not negligible, will not show superconductivity. According to Debye[3] the effect of the lattice oscillations is very small for all temperatures below 1° K. From this we can conclude that substances which do not become superconducting by about 1° K will not at all become superconducting. This seems to agree with the observed fact that the lowest transition temperature recorded[4] is 0·6° K for cadmium.

K. R. Dixit.

Gujarat College,
Ahmedabad,
May 29, 1940.

[1] F. London, *Une conception nouvelle de la supraconductibilité* (Herman, Paris, 1937).
[2] J. C. Slater, *Phys. Rev.*, 1937, **52**, 214.
[3] P. Debye, *Ann. d. Physik*, 1938, **32**, 85.
[4] Smith and Wilhelm, *Rev. Mod. Phys.*, 1935, **7**, 237.

The λ3105, λ3338 and λ3375 Bands of OD.

These bands have been obtained in a water-cooled discharge-tube already described by the author.[1] The heavy water was 99·2% pure and the OD spectrum was free of OH.

The investigation of these bands has been carried out and the rotational analysis completed. The structure is that characteristic of a $^2\Xi \rightarrow {}^2\Pi_{\mathrm{inv.}}$ transition.

Table I

	λ	B_v'	D_v'	B_v''	D_v''
OD	3105	8·695	$-0{\cdot}580 \times 10^{-3}$	9·584	$-0{\cdot}350 \times 10^{-3}$
OH	3122	16·117	$-1{\cdot}98 \times 10^{-3}$	17·809	$-1{\cdot}78 \times 10^{-3}$
OD	3338	9·038	$-0{\cdot}670 \times 10^{-3}$	9·594	$-0{\cdot}395 \times 10^{-3}$
OH	3428	16·924	$-1{\cdot}93 \times 10^{-3}$	17·824	$-1{\cdot}85 \times 10^{-3}$
OD	3375	8·705	$-0{\cdot}599 \times 10^{-3}$	9·329	$-0{\cdot}410 \times 10^{-3}$
OH	3484	16·105	$1{\cdot}96 \times 10^{-3}$	17·150	$-1{\cdot}87 \times 10^{-3}$

The rotational constants are determined and are compared with those for the corresponding OH bands given by Tanaka and Koana.[2]

A full account of the investigation will be published shortly.

M. Ishaq.

Physics Department,
Muslim University,
Aligarh,
May 21, 1940.

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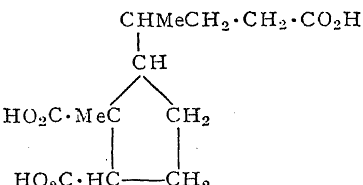
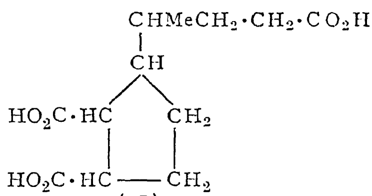
[1] Ishaq, *Proc. Roy. Soc.*, 1937, **159A.**
[2] *Proc. Phys. Math. Soc. Japan*, 1933, **15**, 272.

Experiments towards Synthesis of Wieland's $C_{13}H_{20}O_6$ Acid from Bile Acids

Though the structures for the various sterols, bile acids and allied substances have been laid down with certainty, the available evidence as to the five-membered nature of the ring D in them is only indirect. It would seem to rest mainly on the formation of the Diel's hydrocarbon $C_{18}H_{16}$ from sterols, etc.[1] and on the stepwise degradation of cholanic acid to ætiocholanic acid which latter forms only an anhydride and cannot ketonise[2] (application of Blanc's rule). The oxidation of either desoxycholic acid[3] or 12-ketocholanic acid[4] gave in the hands of Wieland an acid $C_{13}H_{20}O_6$ to which he assigned the structure (I). A synthesis of acid (I) can be expected not only to throw light on the validity of structure (I) but also provide evidence for the five-membered nature of the ring D in steroids. In a series of brilliant papers Baker[5] has described various, if unsuccessful, attempts to synthesise (I), the chief difficulty having been the attachment of the requisite side chain—$CHMe.CH_2.CH_2.CO_2H$ to the relevant *cyclo*pentanone ester. We have taken on hand the synthesis of (I), and as a first step it was considered worthwhile to synthesise (II), the lower homologue of (I). Profiting by Baker's work[5] we have been able


(I)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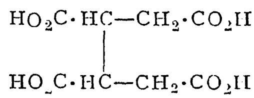
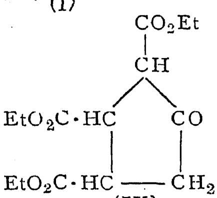
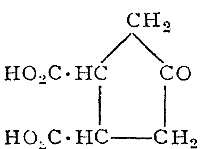
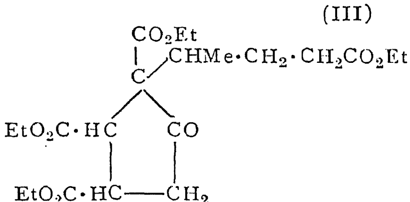
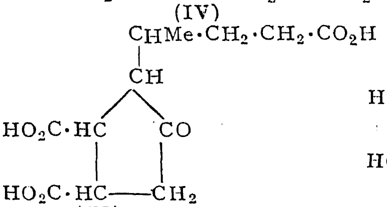
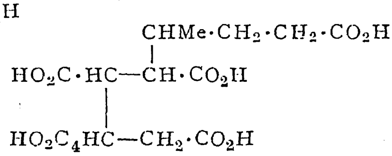

(III)

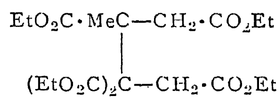

(IV)

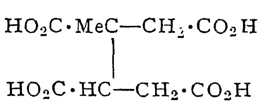

(IV *a*)

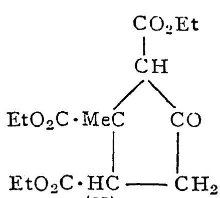

(V)


(VI)


(VII)


(VIII)


(IX)


(X)

to hit upon a new method, and it has been found possible to attach the side chain as in (V).

The Michael addition of ethyl malonate to ethyl aconitate as described by Auwers[6] presented considerable difficulties, but was found to proceed very favourably in the presence of a trace of alcohol-free sodium ethoxide (no solvent being necessary) to yield ethyl *n*-butane-$\alpha\alpha\beta\gamma\delta$-pentacarboxylate, b.p. 195°/3 mm. This on hydrolysis followed by decarboxylation yielded a mixture of the stereoisomeric acids represented by (III) and melting at 189° and 236°. The lower melting acid was found irresolvable, and hence represents the *meso* form. The ethyl ester of the *meso* acid had b.p. 180°/2 mm. and was cyclised to (IV), b.p. 171°/2 mm. The structure of this cyclic ester was proved by its hydrolysis to (IV *a*) previously described by Auwers.[6] After considerable experimenting, it was found that the potassium derivative of (IV) condensed with ethyl *n*-γ-bromovalerate in the presence of an excess of the latter and in the absence of solvents to yield (V) b.p. 218°/2 mm. The hydrolysis followed by decarboxylation of (V) to yield (VI) could not be effected by the usual methods[7] but is however being studied. An attempt to hydrolyse the keto ester (V) to the corresponding adipic acid (VII) and recyclise did not succeed.[8]

In connection with the synthesis of Wieland's acid (I) itself, the addition of ethyl ethane $\alpha\beta\beta$-tricarboxylate to yield what is presumably (VIII), b.p. 207°/3 mm., and the hydrolysis *cum* decarboxylation of the latter to (IX), m.p. 193° (anhydride, m.p. 187°), have been studied. The ethyl ester of (IX), b.p. 186°/2 mm. has been cyclised to (X), b.p. 176–78°/2 mm. The confirmation of these structures is underway. Further work is being continued.

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May 20, 1940.

1 Harper, Kon and Ruzicka, *J.C.S.*, 1934, 124.

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3 — and —, *Ibid.*, 1924, **134**, 276.
— and Vocke, *Ibid.*, 1929, **177**, 88.

4 — and Posternak, *Ibid.*, 1931, **197**, 17.
— and Dane, *Ibid.*, 1933, **216**, 91.

5 J. W. Baker, *J.C.S.*, 1931, 1546; *Ibid.*, 1933, 811.
Baker and Burton, *Ibid.*, 1933, 815.

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The Frequency of the Cell Division in Polyploid Plants

During the last few years I have studied a large number of experimentally produced auto- and allopolyploid plants of various families, genera and species, namely: *Nicotiana*, *Petunia*, *Triticum*, *Triticum-Haynaldia*, *Solanum*, *Lactuca*, *Festuca*, *Beta*, *Taraxacum*, etc. In almost all of the cases tetraploids have a slower development, than the diploids. The average length of the vegetation period of diploid, *Nicotiana rustica*, *N. tabacum*, *N. glauca*, *N. suaveolens*, *Solanum lycopersicum*, *Lactuca sativa*, *Festuca pratensis*, *Beta vulgaris*, etc., is (statistically significantly, or absolutely) shorter than the vegetation period of the tetraploids produced experimentally from these diploids. Autotetraploid *N. Sanderæ* plants have also shorter vegetation periods than the auto-octoploids. F_1-hybrids *Nicotiana multivalvis* × *N. suaveolens*, *N. glauca* × *N. Langsdorfii*; *N. longiflora* × *N. Sanderæ*, *Triticum Timopheevi* × *Triticum monococcum*, *Triticum dicoccum* × *Haynaldia villosa*, etc., have on the average a shorter vegetation period than their amphidiploids. In other words, diploids and F_1-hybrids begin to flower (on the average) and set seeds much earlier than their auto-tetraploids or amphidiploids. The same observations have been recorded by other authors in various plants. The growth curves of the diploids and tetraploids do not coincide. Tetraploids usually begin their development from a much larger

embryo (resp. seed), but diploids, most frequently, grow faster and in most of the cases they are taller when they begin to flower. Tetraploids have usually a somewhat slower growth although in some cases tetraploids may reach the diploids in size and grow even further, *i.e.*, much larger. Detailed investigations in this direction showed that the cell division during the growth and development of most diploid plants and F_1-hybrids is much more frequent than the cell division of tetraploids and amphidiploids respectively produced. Tetraploids behave in the same way to octoploids as the diploids to tetraploids. In connection with these studies another imporant question arises, namely: what is the cause for the slower frequency of cell division in tetraploids and amphidiploids when compared with the cell division frequency of the diploids and F_1-hybrids from which they are produced by chromosome doublings as well as what is the cause for the slower cell division frequency in the octoploids when compared with the cell division frequency in the tetraploids? It seems to me that this phenomenon is a casual consequence of the nucleus size, which is directly influenced by chromosome doubling.

Tetraploid nuclei are much larger than the diploid ones and the octoploid nuclei are much larger than the tetraploid nuclei. The cells of the tetraploid plants and amphidiploid hybrids have much larger nuclei than the cells of the diploid and F_1-hybrids from which the former are derived. The cells of the octoploids also have much larger nuclei than the cells of the tetraploids.

Nuclei usually have spherical or ovoid shapes, consequently the ratio: $\frac{\text{Nucleus surface}}{\text{Nucleus volume}}$, which I shall shortly call *chromosome division coefficient*, will decrease with the increase of polyploidy.

The larger this coefficient is the better exchange of substances takes place between cytoplasm and nucleus, and the more frequent chromosome reproduction and nuclear and cell division occurs.

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April 12, 1940.

Chiasma Frequency in Diploid and Tetraploid Branches in *Petunia hybrida*

A TETRAPLOID-DIPLOID chimera was obtained among the diploid and tetraploid plants of *Petunia hybrida* in treating seed of this plant with 0·25 per cent. colchicine for 36 hours. Tetraploid branches differed morphologically from the diploid ones like the whole tetraploid plants from the original diploids. Since *Petunia hybrida* is a more or less genetically heterozygous plant, its progeny should differ in some respects, no matter how minute they are. Considering this circumstance I studied the chiasma frequency in the tetraploid-diploid chimera instead of in the diploid and tetraploid plants.

In studying 33 metaphases of the first meiotic division of the pollen mother cells of the diploid (Table I) in comparison with 35 metaphases of

TABLE I

Chiasma frequency in the diploid branch

$2n$ Petunia branch	Number of chiasmata per pollen mother cell								n	M_d	σ
	8	9	10	11	12	13	14	15			
Number of pollen mother cells studied	2	5	7	8	6	1	3	1	33	11·3	1·72

TABLE II

Chiasma Frequency in the Tetraploid Branch

4n Petunia Branch	Number of chiasmata per pollen mother cell																n	M_t	σ
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27			
Number of Pollen mother cells studied	1	0	1	2	2	4	3	5	4	3	4	2	0	1	2	1	35	19·6	3·45

the tetraploid branch (Table II) I found that the average number of chiasmata per cell in the diploid, M_d, was 11·3, while that in the tetraploid was 19·6, which means that diploid pollen mother cells have on the average 1·6 chiasmata per metaphasal bivalent, while the tetraploid cells have only 1·4 chiasmata. In other words $2M_d - M_t = 22\cdot6 = 19\cdot6 = 3$ and $M_d - \frac{1}{2}M_t = 1\cdot5$.

It should be pointed out that the numbers of the chiasmata per cell are more variable in the tetraploids, $\sigma = 3\cdot45$, than in the diploids, $\sigma = 1\cdot72$. Tetraploid pollen mother cells had often metaphases with one, two or even more quadrivalent groups. Univalents, 1 — 3, as well as trivalents were also observed.

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A Case of Vivipary in Rye

VIVIPARY was observed in a large number of grasses by many investigators (Turesson,[1] Stahlin,[2] etc.).

It maintains sometimes polyploidy, although it is not a sequence of poliploidy (Kostoff[3]). During the last two years I observed viviparous plants, among the progeny of the back cross (*Secale cereale* × *S. montanum*) × *S. cereale* in the eighth generation.

Viviparous forms were detected among the perennial forms of the segregates when they overwintered in the green house and grew for several months at a relatively low temperature (0–10° C.). Viviparous plants formed spikes (Fig. 1) which had rootlets at the nodes. Most of the spikelets had small rootlets. Instead of anthers and ovaries, the spikelets formed leaves and developed further into normal stems with normal leaves. Spiklets with small roots,

FIG. 1
Viviparous spike of rye

transplanted vegetatively into pots developed further giving rise to adult plants. When the temperature in the green house was raised above 15° C. they developed into normal plants, *i.e.*, with sexually normal spikes, the flowers having anthers, ovaries and styles. All of the plants produced by viviparous propagation set quite normal seeds during the summer.

The case of vivipary in rye, which I had, is a special one. The phenomenon, vivipary, was observed only when the plants grew at low

temperature. This case is very interesting from a *phenogenetic* point of view. The same genotype reacts strikingly differently to low and high temperatures. At the former environment formative processes for the realization of typical flowers proceeded in a definite direction so that instead of floral organs (anthers, ovaries), leaves and further small shoots (stems with leaves) with roots, were formed on the spike axis.

The same genotypes react to higher temperature by forming normal sexual organs (anthers and ovaries) and normal sex cells, the necessary elements for realization of sexual propagation.

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May 21, 1940.

1 Turesson, *Hereditas*, 1930, **13**, 177.
2 Stahlin, *Wis. Arch. Landwirtsch*, Bd. I, 1929.
3 Kostoff, *Curr. Sci.*, 1939.

Pseudogamy in Genus Brassica

SINCE the time Focke[1] introduced the term "Pseudogamy" to explain the origin of maternal hybrids by the fact that the pollen in such cases does not take any part in fertilization, but acts merely by stimulating the egg-cell in some way so as to enable it to develop into an embroyo apomictically, this phenomenon has been found to be fairly widely spread in plants. In interspecific and intergeneric crosses particularly, individuals arise frequently which are not true hybrids, as they carry nuclear factors from one parent only and are, therefore, either metromorphic or patromorphic according to the derivation of their genetic factors. Although some cases of patromorphic hybrids have been authenticated by Clausen and Lammerts[2] in *Nicotiana*, and Collins and Kempton[3] in *Tripsicum* X *Euchlaena*, the exact conditions giving rise to Androgenesis are not yet properly understood. In contradistinction to this, the origin of metromorphic hybrids has been demonstrated more concretely, both cytologically and genetically in a large number of cases by several workers and a number of explanations, which have been detailed by Sharp,[4] have been given for the origin of such plants.

In the genus Brassica, to the knowledge of the authors, the only case of pseudogamy that has been reported in literature is by Nogouchi[5] in the cross *B. campestris*, L. Var. *oleifera*, D.C. X *B. oleracea*, L. Var. *gemmifera*, D.C., which gave purely maternal offsprings in F_1 which bred true in later generations. Cytological observations made by him showed that although the two male nuclei carried by the pollen tube penetrate into the egg-apparatus, neither of them actually fuses with the egg nucleus or one of the polar nuclei, and that both of them ultimately disintegrate into small fragments. The young embryo was found to be developing about 5 days after pollination, although the complete process of embryonic development was not traced.

The observations carried out by the authors of this note at Lyallpur since 1937 on the progeny of a large number of interspecific crosses made with the object of finding out the crossability and natural affinities of the various so-called species of Brassica show that pseudogamy is a regular phenomenon in this genus, being prevalent on a much larger scale than hitherto believed. The details of the various crosses made and studied by the authors, including the setting percentage of pods and seeds, and the number of maternal and true hybrids in each case, are given in Table I from which it will be seen that excepting two crosses, in which all the F_1 plants turned out to be true hybrids, showing abortive pollen due to chromosome aberrations and intermediate morphological characters between their respective parents, all others produced nothing but maternal offsprings which resembled the female parent in all their morphological characters, *viz.*, shape and hairiness of leaves and stems, stature of plants, time of flowering, size and shape of pods, seed colour, soundness of pollen, and fertility, etc. This leaves no ground for any doubt about their apomictic origin. In the

TABLE I

Cross	No. of flowers crossed	No. of pods formed	% setting	Total number of seeds obtained	No. of seeds germinated/sown	No. in F_1 of	
						True hybrids	Maternal hybrids
B. campestris, L. Var. *sarson*, Prain (2 *n*= 20) × *B. Tournefortii*, Gouan. (2 *n*= 20)	41	4	9·7	13	10/10	0	10
B. Tournefortii (2 *n*= 20) × *B. campestris*, L. Var. *sarson* (2 *n*= 20)	25	25	100·0	14	9/10	0	9
B. campestris, L. Var. *sarson* (2 *n*= 20) × *B. juncea*, Coss. (2 *n*= 36)	38	15	39·4	1	1/1	0	1
B. juncea, Coss. (2 *n*= 36) × *B. campestris*, L. Var. *sarson*	29	21	72·4	32	18/25	18	0
B. nigra, Koch. (2 *n*= 16) × *B. campestris*, L. Var. *sarson* (2 *n*= 20)	29	5	17·3	10	7/8	0	7
B. nigra, Koch. (2 *n*= 16) × *B. Tournefortii*, Gouan. (2 *n*= 20)	32	23	71·8	24	17/20	0	17
B. napus, L. Var. *dichotoma*, Prain (2 *n*= 20) × *B. juncea*, Coss. (2 *n*= 36)	37	31	83·8	6	4/6	0	4
B. juncea, Coss. (2 *n*= 36) × *B. napus*, L. Var. *dichotoma* (2 *n*= 20)	57	48	84·3	185	44/50	44	0

latter case, therefore, it seems logical to believe that the pollen takes no part in actually fertilising the egg-cell, but simply helps it to develop into an embryo with the maternal zygotic chromosome number. Cytological evidence for the actual process of embryonic development will form the subject of a separate note when studies on this aspect have been completed.

A point of practical importance emerging from these studies is that in all cases of compatible matings, where true hybrid plants have been obtained, the female parent had higher number of chromosomes than the male parent. The crosses of brown *sarson* (*B. campestris*, L. Var. *sarson*, Prain) and *toria* (*B. campestris*, L. Var. *dichotoma*, Prain) with *B. juncea* mentioned in the table, substantiate this fact conclusively. In both these crosses when *B. juncea*, which has $2n = 36$ chromosomes as compared to $2n = 20$ of each of *sarson* and *toria*, formed the female parent, not only were true hybrid

TABLE II

Cross	No. of flowers crossed	No. of pods formed	% setting	Total number of seeds obtained
Toria ($2n = 20$) × (*Raya* × *toria* F_1) ($2n = 28$) ..	48	43	89·9	2
Raya ($2n = 36$) × (*Raya* × *toria* F_1) ($2n = 28$) ..	183	155	84·7	81
(*Raya* × *toria* F_1) ($2n = 28$) × *Toria* ($2n = 20$) ..	56	29	51·8	27
(*Raya* × *toria* F_1) ($2n = 28$) × *Raya* ($2n = 36$) ..	138	55	39·9	0
B. juncea, Coss. ($2n = 36$) × *B. nigra*, Koch. ($2n = 16$)	69	69	100·0	17
B. nigra ($2n = 16$) × *B. juncea* ($2n = 36$)	96	81	85·0	0

seeds obtained, but the setting of seeds was also much higher than in the corresponding reciprocal crosses. The validity of the latter fact is further proved by the results of the fresh and back-crosses made during the crop year 1939–40 (Table II).

It is not the purpose of this note to go into the question why pollinations between two species succeed more often when the species with the higher chromosome number is the female parent than in the reciprocal, nevertheless it appears very likely that the governing factor in such cases may be the pollen tube growth in relation to the constitution of the tissue of the style as suggested by Watkins[6] in the case of *Triticum* and other genera.

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1 Focke, W. O., *Die pflanzen mischlinge*, Berlin, 1881.
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4 Sharp, L. W., *Introduction to Cytology*, 3rd edition, 1934.
5 Nogouchi, N., *Proc. Imp. Acad.*, Japan, 1928, 617.
6 Watkins, A. E., *Jour. Genet.*, 1932, **25**, 125.

The Inheritance of Hairy Styles (and Barbed Columns of Awns) in Sorghum

IN Sorghum, as in many grasses, the stigma has distinct stylar and stigmatic areas. The stigmatic portion is always feathery, but the feathers may vary in their length and distribution.[1,2,3,4] As for the style, it is usually smooth. A rare instance in which the stylar arms are hairy has already been noted. This occurred in a variety of *Sorghum papyrascens* Stapf (*S. membranaceum*, Chiov.) and its presence concurrently with the homologous barbed columns of the awn has been recorded.[5]

The reasons for considering *S. membranaceum* as a probable mutant form of *S. cernuum* Host. have been adduced in a previous article.[6] An examination of the *S. cernuum* group of Sorghums shows, that hairy styles occur in three other varieties belonging to this group. This provides additional evidence about the affinities between the two groups of Sorghum. Hairy styles have thus a constancy in occurrence. They have now proved a heritable character also.

A cross was made between A.S. 4249 (*S. cernuum* Host.) with hairy stylar arms and barbed columns and A.S. 29 (*S. durra* Stapf) with smooth stylar arms and smooth columns (all columns of awns in Sorghum are usually

smooth except for broadly serrated edges on either side of the grove on the inner side of the column). In the F_1 the stylar arms were hairy, more so towards the inner side. The column of the awn was barbed, the concentration of barbs being on the two edges of the columnar grove. The F_2 gave a clear segregation for hairy stylar arms and barbed columns of awn (225) and smooth stylar arms and smooth columns of awn (80). In the F_3 generation, the smooth selection bred true. Of the four hairy selections, one bred pure and the other three segregated giving a total of 516 hairy to 160 smooth. It will thus be seen that this homologous pair went together and proved a monogenic dominant.

The two parents figuring in this cross differed in other characters also and cross-collations between this rare character and other contrasting characters give independent di-hybrid segregations for hairiness of node, yellow colour of grain, the Q factor for leafsheath-glume colour and felty hairs on glumes.

In Sorghum, as in many grasses, the homologous stylar-arms and awn-columns are usually smooth. In rare instances there could be hairy styles, and barbed columns. This condition is heritable and is a monogenic dominant.

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1 *The Ind. Jour. Agrl. Sci.*, 1936, **6**, 1313.
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Sorghum—Awns of Inconstant Length and Their Inheritance

The spikelets of sorghum may be awned or awnless. When awned, the awns vary in length. They may be short or long and grade up or down in length. In cultivated sorghums, awn length is generally delimitable within a variety with a fluctuation of about 2 mm. The tops of the earheads tend to have the longer awns in greater numbers. This is common with the generality of the cultivated sorghums.

An exception to this condition occurs in *Sorghum guineense* Stapf, a group of sorghums from Nigeria in Africa. Most of the varieties in this sorghum have short awns, the commonest length being 3 to 5 mm. Instead of the length fluctuating within sharp limits (with obviously stray shorter and longer ones), there is in this group a regular gradation in awn length starting from small points (looking almost awnless) to awns up to 9 mm. in length. There is thus a manifestation of awn length that is inconstant ranging from 1 to 9 mm. with the bulk of them at 3 to 5 mm. Unlike the other sorghums with well-defined awn length groups, in *S. guineense* the tendency is for awns of longer length to be more towards the base of the panicle instead of at the top. The result of this wide range in awn length and its distribution in the earhead is to give this type of head a checkered look as far as awn length goes, in contrast to the easily recognisable awn groups of other sorghum varieties.

S. coriaceum Snowden, stands for the normal type of awns. Family No. A.S. 4143 is a type belonging to this group, with awns 9 to 11 mm. in length. In this there occurred a natural cross with awns 5 to 7 mm. in length. From the characteristics of the F_1, and the behaviour of the F_2 and F_3 generations, the pollen parent could easily be traced to the group *S. guineense* Stapf. This F_1 was sown and segregated for awn length giving a range from 1 to 15 mm. The constancy and the inconstancy of the manifestation of awn length was not easy of pursuit in the shorter reaches of awn range—3 mm. and below; but in lengths from 5 mm. and upwards, the constancy and inconstancy of awn length could be judged. There were 126 constant and 41 inconstant manifestations. From this F_2, selections were taken with a maximum awn length of 9 mm., 4 selections with awns 7 to 9 mm. (constant manifestation)

and 2 with awns 1 to 9 mm. (inconstant manifestation). The 2 latter bred true in the third generation. Of the 4 former one bred pure for 7 to 9 mm. and the 3 others segregated again giving a total of 248 plants with awns of constant length (7–9 mm.) and 82 with awns of inconstant length (1–9 mm.). An analysis of panicles of the inconstant length type shows the following distribution in awn length within the earhead (average of 5 panicles).

9 mm. and below	.. 133
7 mm. ,,	.. 340
5 mm. ,,	.. 481
3 mm. ,,	.. 753
1 mm. ,,	.. 385

This large representation in every group of awn length, gives the earhead its checkered appearance due to the inconstancy in the length of the awn.

It will thus be seen that in *S. guineense*, Stapf the manifestation of the awn is inconstant in length varying within wide limits and that this type of inconstant awn is a monogenic recessive to the common manifestation of awn length, which is in well-defined and easily classifiable length groups.

G. N. RANGASWAMI AYYANGAR.
T. VENKATARAMANA REDDY.
Millets Breeding Station,
Coimbatore,
May 23, 1940.

Distillery By-product—Yeast

A BY-PRODUCT in the alcoholic fermentation of molasses, yeast is obtained as a deposit mixed with calcium salts, and is sufficiently rich in nitrogen, phosphate and potash to be used as manure alone or as admixture with compost. The yeast occurs also in suspension in the fermented solution to the extent of 0·75 per cent. by volume, which can be recovered by centrifuging. Together, the yeast takes up 70 per cent. of the nitrogen present in the fermenting liquid; 93 per cent. of the phosphate and 3·2 per cent. of the potash in the molasses are also utilised. Removal of suspended yeast by centrifuging the fermented wash, prior to distillation, is good practice as it reduces the fouling of distilling plates. The spent wash or slop, then, contains the rest of the salts mainly potash which is recovered conveniently by evaporation.

100 tons of molasses on fermentation, deposit 6 tons of yeast sludge which after washing and settling yield 2 tons of air dried yeast. A proximate analysis of the yeast and the distribution of N, P and K_2O are given in Tables A and B.

TABLE A

	Molasses %	Dry Yeast %	Slops (free from Yeast) %
Nitrogen ..	0·5	8·5	0·05
Phosphate ..	0·2	3·5	0·003
Potash ..	3·5	2·1	0·83

TABLE B

Molasses + Am. Salt	Yeast		Slops
	Deposit	Suspension	
100 + 0·7 tons	2 tons	3·33 tons	91,000 gals.
Nitrogen, 1,434 lbs.	380 lbs.	634 lbs.	420 lbs.
P_2O_5, 448 lbs.	156 lbs.	262 lbs.	30 lbs.
K_2O, 7,840 lbs.	94 lbs.	157 lbs.	7,589 lbs.

The yeast deposit is generally washed out in distilleries. The recovery of this yeast as a supplementary nitrogenous and phosphatic fertiliser would be worth while.

Y. K. RAGHUNATHA RAO.
Distillery, Mysore Sugar Co.,
Mandya,
May 18, 1940.

On *Corticium album* of Dastur

IN 1938 Dastur observed some orange trees at Burhanpur, the lower parts of which were covered by a *Corticium*. The mycelium was wholly superficial, a few hyphæ filling the crevices formed by the cracking of the bark,

Dastur[1] (1940) considered it to be different from *Corticium koleroga* (Cooke) v. Höhnel or *C. salmonicolor* B. and Br. both of which have been recorded on *Citrus* and are parasitic in nature. He submitted the fungus to Dr. H. S. Fawcett for opinion who wrote that it was something with which he was not familiar. Dr. J. N. Couch to whom the specimen was also sent, found it impossible to pass judgment on material preserved in formalin but considered it safe in describing it as a new species, and the name *Corticium album* has been proposed for it by Dastur (1940).

Saccardo lists 413 species of *Corticium* up to the year 1925 and since then more species have been described. Monographic studies on the genus have been published by von Höhnel and Litschauer (1906–08)[2] and Burt (1926)[3]. It was found by von Höhnel and Litschauer (1906)[4] that many determinations of *Corticium* spp. in Schroeter's 'die Pilze' are incorrect and they state (1906–08) that there are several mis-determinations in the *exsiccatae* distributed by Rabenhorst, Saccardo, Sydow, von Thümen and others. Rogers (1935)[5] is of the opinion that there has been a heterogeneous accumulation of species within this genus. Corticiums are generally saprobes or facultative parasites (Dastur's fungus is only an epiphyte) and host specialization can hardly be assumed to exist. The task of determining species or of establishing new species in this genus is therefore difficult and has been a pit-fall to many mycologists. The status of Dastur's fungus can be accurately decided therefore only by a comparison of it with type specimens or *exsiccatae* revised by von Höhnel and Litschauer (l.c.).

Dastur followed Clements and Shear (1931)[6] in assigning the fungus to the genus *Corticium* but since that work was published, the basidial morphology of the Thelephoraceae has been critically studied by Rogers (1934)[7] who (1935) has proposed one new genus, *Ceratobasidium*, and accepted another, *Botryobasidium* Donk, into which have been merged several species formerly included in the genus *Corticium*. But assuming that Dastur's fungus is a *Corticium*, the name *C. album* is not tenable, for it had been used by Britzelmayr (1897)[8] for a *Corticium* occurring on oak logs at Augsburg, Bavaria. If Dastur's fungus is a new species, then he will have to choose another name for it and, incidentally, supply also a latin diagnosis.

B. B. Mundkur.

Imperial Agricultural Research Institute,
New Delhi,
May 23, 1940.

1 Dastur, J. F., *Ind. J. agric. Sci.*, 1940, **10**, 89.

2 Höhnel, F. V., and Litschauer, V., *Sitzb. Akad. Wiss. zu. Wien. Math. Nat. Kl.* Bd. 1906-08,115-17, I-III.

3 Burt, E. A., *Ann. Mo. bot. Gdn.*, 1926, **13**, 173.

4 Höhnel, F. V., and Litschauer, V., *Ann. mycol. Berl.* 1906, **4**, 288.

5 Rogers, D. P., *Univ. Iowa Studies in Nat. Hist.*, 1935, **17**, 1.

6 Clements, F., and Shear, C. L., *Genera of Fungi*, New York, 1931, p. 161.

7 Rogers, D. P., *Univ. Iowa Studies in Nat. Hist.*, 1934, **16**, 160.

8 Britzelmayr, M., *Bot. Zbl.*, 1897, **71**, 95.

Nitric Nitrogen in Soils under Cotton

Madhok and Fazal-ud-din[1] suggest a probable cause of the partial failure of cotton in the Punjab from their observations on the nitric nitrogen content of soils under cotton. This evidently means that they believe the nitric nitrogen status of the soil under cotton and the yields to be in some way correlated. Two questions thus arise: (1) Is the nitric nitrogen content of the soil at any time a reliable measure of the fertility or crop-producing power of the soil? (2) If so, have Madhok and Fazal-ud-din adduced any substantial evidence in answer to this question?

We may, in the first place, refer to available literature in regard to question No. 1. There is abundant evidence to show that the nitrate content of the soil under crop is influenced by such a large number of factors that so far it has proved useless as a reliable

fertility index of the soil. This is not the occasion to discuss these factors at length and therefore a few salient points are briefly referred to below:—

(*a*) Nitrate might be lowered in the soil due to absorption either by plants or micro-organisms; in fact the nitrate content of the soil at any time is a balance between its production and removal by plants or micro-organisms.

(*b*) It has been observed that some plants *e.g.*, corn, favour nitrate accumulation during the early stages of development, whereas grass and wheat tend to depress it.

(*c*) Fallow land has been found to be richer in nitrate even after allowing for the amount taken up by the plant.

(*d*) Nitrate is formed more rapidly in soil taken from near the roots than in the soil free from them, even though the former contains very small quantities of nitrate at the time of sampling.

(*e*) The ridges of Sudan Gezira cotton soils often have high nitrate content (due to capillary rise) when the crop is obviously suffering from nitrogen shortage.

We may now examine the observations recorded by Madhok and Fazal-ud-din.

The 1929–33 data are the most exhaustive as samples were collected at weekly intervals. Unfortunately several important details have not been given. It is not clear what horizon does the soil sample constitute. Does each figure represent a single sample or a mean of several replicates? The 1939 data lose whatever significance they may have because they were collected only in September and on individual plots under different varieties of cotton. Absence of nitrate might mean that it was absorbed as fast as it was produced. Again no attempt has been made to show any correlation between nitrate content and crop yields. For a proper correlation study yields and nitrate contents should be compared in different plots in the same year, or if these two sets of data collected from the same field belong to different years the influence of climate, insect and other pests, etc., should also be taken into account. Further the writer has ascertained that the fields of the Lyallpur Agricultural Farm, of which the authors determined the nitrate contents (results given in Table II) in September 1939, produced yields varying from 9 to 13 maunds per acre, which appear to be quite normal.

In the face of above arguments, the authors' final conclusion that "Deficiency of available nitrogen in soils under cotton at the fruiting stage of the crop may have something to do with its partial failure", remains only a speculation. It may be emphasised that the writer does not take up the position that nitrogen is not a factor in the production of cotton in the Punjab; in fact, this is one of the main findings of the extensive investigations carried out, on lines other than the one under consideration, in the Punjab Cotton Failure Scheme at Lyallpur, which is financed by the Indian Central Cotton Committee and the Punjab Government. The writer has also found a roughly inverse relation between nitrate content and crop yields. In conclusion, the writer thus wishes to point out that the details and data, so far furnished by Madhok and Fazal-ud-din, do not in any way justify the conclusion they draw.

R. D. Asana.

Bulsar,
April 29, 1940.

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[1] *Curr. Sci.*, 1939, **8**, 551.

REVIEWS

The Travancore Tribes and Castes, Vol. 2. By L. A. Krishna Iyer. (Government Press, Trivandrum), 1939. Pp. 344.

Eight tribes of the Travancore State are described here in the same schematic manner that was followed in the first volume of the series reviewed in these columns (*Curr. Sci.*, 1938, 7, No. 6). This synoptic treatment which pigeon-holes the data has just one advantage, namely, that it makes references easy, but the disadvantages are that no analysis is possible, and readers cannot hope to have any concrete impressions of the tribal cultures. But this method was found to be good for the purposes of the ethnographic survey initiated by Risley at the beginning of the present century. The intention of the organisers of the survey then was that the preliminary work of the survey should be followed up by detailed monographs on each tribe. We hope that the short accounts that have now been published will be amplified by more intense field work. A good example has been set in this direction by the Government of Assam.

Any one who understands the difficulty in collecting authentic ethnographic data in the tropical jungles, will give credit to the author for the industry and enthusiasm that he has brought to bear on this piece of work.

Prof. E. von Eickstedt of the Breslau University contributes an introductory essay on the history of anthropological research in India which he uses mainly to answer Dr. Guha's criticism of his scheme of racial classification of the peoples of India. It is difficult to understand the relevancy of this extremely controversial contribution to the main theme of the book which it is supposed to introduce. The author has, moreover, accepted in the last chapter of his book those very terms which have been criticised by the German professor (see pp. 290–94). Several passages of this introduction are unreadable and obscure. A specimen is quoted here:

> The difference between a people and a race therefore is that the people show many different zoological types of same and very near descent, but the race exhibits only one single zoological type of same and more distant descent. Both have same descent—no wonder that they are confounded or the people, this group of same descent, language and history, called "race". (p. xvii).

Good taste is obviously lacking when Eickstedt himself writes of his expedition—it consisted of himself and his wife—as "the greatest expedition which ever studied a foreign country from only the bioanthropological point of view".

In spite of all the published evidence to the contrary, Eickstedt persists in his belief that "genuine frizzly hair has therefore naturally been never found in India". While he rules out the *negrito* strain, he has no difficulty in admitting a *negrito-like* strain in the jungle tribes of the Peninsula!

The problems of racial nomenclature raised by Eickstedt are too complex to be solved in an introductory essay like the one he has contributed to the volume under review. A good deal more of data and discussions will be necessary for their solution. It is doubtful if Eickstedt will find supporters in creating new subspecies, as it is against modern taxonomic trends. The reviewer feels that Mr. Iyer has added very little to the value of his excellent book by this irrelevant introduction.

The illustrations are more carefully selected than in the first volume and the get-up is definitely better.

A. AIYAPPAN.

Mechanics Applied to Vibrations and Balancing. By D. Laugharne Thornton. (Chapman & Hall, Ltd., London), 1939. Pp. 529. Price 36*sh*.

The book is written primarily for Engineers and each chapter has been developed from the simplest beginnings, the fundamental principles being expounded as clearly as possible. A fairly good knowledge of mathematics is assumed on the part of the reader. A major portion of the book is devoted to demonstrate the bearing which unbalanced machinery in general and engines in particular have on the vibration of the foundations or supporting structures. In the first and second chapters this is exemplified with reference to the balancing of steam and internal combustion Engines and of Locomotives. Lagrange's equations have been enunciated and employed in these two chapters. This makes it easy for one to follow

the more advanced theory of vibrations in Chapter III. Investigation of the vibration of structural systems having a definite number of degrees of freedom is made extremely simple by Lagrange's formulæ. The main points in the design of an engine as a whole and of the various components as the governor, valve gear, etc., can be easily followed by the information provided in Chapters III and IV which deal mainly with the propagation of stress through elastic materials. These chapters are full of interest to the Engineer. Stresses induced while driving a pile, in winding ropes, in materials used for construction, in reinforced concrete, in propagation of torque in a shaft, in water hammer, in earthquakes, in impact, etc., are clearly brought out and illustrated by numerical examples where possible. The study of continuous wave motion, transmission of energy by pressure waves, and the application of pressure waves to study the fuel system of internal combustion engines are also very ably developed in this chapter. Problems arising from the vibration of beams under various conditions of support for the ends, of struts and ties, of continuous beams and of framed structures with rigid joints are discussed at length in Chapter V.

In the same chapter the more difficult problem of the vibration of a thin plate of rectangular and circular sections is introduced and this leads the reader on to an understanding of the behaviour of beams of non-uniform cross-section and of combined transverse and torsional vibrations. The significance of the several results obtained in this and the previous chapters is further brought out by a discussion of the possible causes and the general character of the vibrations in the fuselage of aircraft, specially when executing manoeuvres, at the end of the chapter. A detailed analysis of the vibration of rotating shafts and discs, is given in Chapter VI and the results are applied to the study of the wheel and blading of a turbine and the gyroscopic action of rotating bodies is here illustrated with reference to the influence of the gyroscopic forces on the disc wheels of marine turbines caused by 'pitching' or 'yawning' motion of the vessel. Under the heading 'General Survey' the last chapter in the book is made probably more interesting than the previous ones, to the lay reader, as it is completely devoid of any mathematics. It deals with the vibration met with in ships, propelled by oil engines and turbines, with the appliances for the purpose of damping vibration caused by machinery in general and engines in particular, with the torsional vibration of crankshafts, with the vibration of a railway bridge when a locomotive passes over it, and with traffic and vibration of roads; also with the application of wave forms in Geophysical, Marine and Aerial Surveying and finally with the design of buildings to withstand earthquakes.

An engineer engaged in design work cannot afford to lose sight of the very valuable information contained in this chapter and in the whole book if his design is to be a practically sound one.

E. K. RAMASWAMY.

An Elementary Text-Book of Zoology. By B. L. Bhatia. Third Edition. (Macmillan & Co., Ltd., London), 1940. Pp. 655. Price Rs. 8.

The third edition of this book, specially intended for the use of Intermediate students in India, has just been published. The popularity of this book can be judged by the fact that, though the second edition was printed in 1938, a new edition had to be brought out now, and there is no doubt whatsoever that this popularity is well deserved. Based on Parker and Parker's *Elementary Course of Practical Zoology* and adapted as far as possible to the needs of the Indian student, the book incorporates much of what is known of Indian Zoological types. *The Indian Zoological Memoirs*, which have so successfully contributed to our knowledge of the Zoology of Indian animal types, have been used to much advantage, and the book has made Zoology a more familiar and easily understandable subject to the Indian student.

To meet and fulfil the needs of the Intermediate student throughout India is an ambitious programme, and there are bound to arise variations and deficiencies, which in the nature of things, cannot be completely avoided. These difficulties become the more numerous, if the author keeps in his view a published book and sets out to adapt it to the needs of the students of a country different from those for whom the original book intended. Dr. Bhatia has endeavoured to overcome these difficulties. The type system followed by the Parkers in their book has been slightly altered to make it a general

text-book by the addition of the characters of the class to which the type belongs.

Nearly a third of the volume deals with the frog. The invertebrates are covered in about 200 pages. The sponges, Echinoderms and the parasitic worms are included in "other phyla" covering less than fifteen pages. The lower vertebrates are also treated scantily in about 30 pages while the Rabbit is dealt with in detail covering nearly a hundred pages. It should be possible to accord a more uniform treatment to some of the phyla and in many Indian Universities, the frog and the rabbit are not the only animals which are dealt with in detail. The parasitic worms can be included for a fuller treatment with advantage and interest to the young student, and so can many of the lower vertebrate groups. The third part of the book incorporating certain general principles in Zoology forms a useful and interesting adjunct.

In a book intended for Indian students it is to be expected that Indian examples are cited wherever possible, and this could have been done in the author's classification of the Amphibia on page 202. *Tylototriton* occurs in Darjeeling and at least four genera of Gymnophiona are reported from India.

While we do not doubt that this book will see an Indian student through his Intermediate examination, much of it can be learnt at a later stage, while a little more is needed to equip him for it. B. R. S.

Elementary Microtechnique. By H. A. Peacock. Second Edition. (Edward Arnold & Co., London), 1940. Pp. vii + 330. Price 9*sh.*

We welcome the second edition of *Elementary Microtechnique,* in the compilation of which the primary object of the author has been, besides discussing the chemistry of the various processes of fixing and staining, to provide an inexpensive ready-reckoner to students of Biology. A graded selection of type methods for making microscopic preparations has been added. In describing the dehydrating agents like alcohol, cellosolve, and slovax, dioxan is also described; however, since the dioxon vapour is considered to be deleterious, the beginner may not be recommended to try it. A detailed method is described for making permanent preparations of nephridia of Lumbricus and the same method will not hold good for leeches. It would have been well if the author had also detailed a special method of making whole mounts of the excretory organ of hirudo.

In High Schools and Intermediate Colleges, where microscopic preparations are demonstrated, a book like this will be of immense use, the prohibitively costly treatises being out of question. L. S. R.

Intermediate Botany. By L. J. F. Brimble. Second Edition. (Macmillan & Co., Ltd., London), 1939. Pp. viii + 562. Price 8*sh.* 6*d.*

This is the second edition of the author's book, well known for the very desirable and welcome departure from the traditional method of writing text-books. By including topics of economic significance and human interest, the author has made the treatment more truly *educational.* Thereby he has not only given a refreshing orientation to and served to vitalise the study of plants, but has also succeeded in liberating the subject from the shackles of the stereotyped method of writing botanical treatises, hitherto dominantly in vogue. One must confess to a feeling of surprise at this consistent indifference to and avoidance by the authors, of the inclusion of topics of interest and utility to mankind, notwithstanding the immense importance of plants in the human and world economy, and the dominant, almost exclusive control which they have on the maintenance and the advance of civilisation. Such an attitude, moreover, has had a very baneful effect on the promotion of the study of Botany, which is generally relegated to an inferior and backward position in the educational curricula, at least in this country, or is at best tolerated as a necessary evil, having no redeeming feature much less any value. The contrast becomes only too obvious when one compares text-books on Physics and Chemistry, which deal not only with purely academic aspects, but have invariably included in their treatment numerous topics of daily interest and utility to man, exemplifying the applications of the findings of these sciences to the amelioration of the conditions of mankind and to the various industrial and manufacturing processes which have contributed so much to the advancement of civilisation. It was high time, therefore, that some one should usher a new era in the preparation of the botanical text-books also. All students and teachers, as well as the general reader, have reason

to feel profoundly grateful to the author for producing a book which makes good this deficiency and, moreover, is written in a manner which at once makes it informative and readable.

For the rest the book follows in detail the lines of treatment of the earlier edition. As in it, there are 30 chapters covering 562 pages, including an appendix of Questions and Exercises. *Little new matter* has been added. In spite of the words of the author: "Advantage has been taken .... to correct errors or incomplete statements and to make improvements wherever possible" certain relevant suggestions and criticisms offered on the first edition remain unattended to. For example, the necessity of indicating the mother axis in the floral diagrams (p. 321); the statements: (1) "the most changeable organ of the plant is the flower" (p. 500) and (2) "the classification of Linnaeus is still the basis of the present-day classification, but much modified" (p. 500–1). There is no doubt that these statements are involved, if indeed not incorrect, as they stand, and the value of the book would greatly be enhanced if these are rectified. It may also be pointed out that in the list of the points of difference between animals and plants (p. 7) no mention is made of two of the most important and fundamental features, *viz.*, (1) the presence of chlorophyll in plants and its absence in animals and (2) the presence and absence of a mouth in animals and plants respectively. In a way these underlie all the other differences between the members of the two great kingdoms, and, furthermore, are so obvious. In connection with the life-history of *Phytophthora* (p. 396) no account is given of the sexual mode of reproduction. This phase is now fully worked out, and without it the life-history remains necessarily incomplete. The plant is stated to be 'multicellular', but the hyphæ are mentioned as 'non-septate'. This discrepancy should be corrected.

While every author has his own notions of, and reasons for what to include and what to exclude—and opinions in this respect will continue to differ—it will be readily admitted that Mr. Brimble has produced a well-balanced work, in which every aspect receives its due share of attention, and in which the academic and the utilitarian points of view are happily blended. Certain topics like the historical survey, enzymes, irregular nutrition, length of life, hormones, uses of plants and plant products to man, vitamins, beverages, to mention only a few, which are either not included at all in text-books, or are treated purely academically, are dealt with by the author with an attractive covering of related phenomena and wider applicability. Such a treatment enriches information, enlivens the study, as well as focusses and stimulates the attention of the reader.

Altogether the book is very well planned, written attractively and is sure to benefit those who may turn to its pages for information and instruction.

The author as well as the publishers are to be heartily congratulated. N. K. T.

Botanisk Genetik Sartryck ur "Vaxternas LIV, Populärvetenskapling Handbook". Band III och. IV. By K. V. Ossian Dahlgren. (Nordisk Familjeboks Förlags A.-B., Stockholm), 1936–38. Pp. 502–692, 1–249.

The book is divided into two large parts each one having 16 chapters thus covering all principal and some more special problems in the field of plant genetics. The field of polyploidy and plasmatic inheritance are broadly discussed. Even such important problems as the origin of the species and the improvement of the plants (plant breeding) have found consideration. Plant geneticists have felt the lack of such a book for a long time. It is very well illustrated with photographs, drawings and diagrams and even with colour plates. Good photographs are given of prominent geneticists, cytogeneticists and plant breeders. It is to be regretted that the book is published in Swedish. The desire of the geneticists of several parts of the world is that the second edition of this book should be published in English or German, serving thus the needs of a larger number of students. It is also hoped that all the more recent discoveries in the field of plant genetics will be considered.

DONTCHO KOSTOFF.

Non-ferrous Foundry Practice. By J. Laing and R. T. Rolfe. (Chapman & Hall, Ltd., London), 1940. Pp. vii +336. Price 21*sh.*

Successful production of castings in the non-ferrous metals and alloys is the realm of the expert. The knowledge of the expert has been made available to us in the present book. The first two chapters deal with moulding sands and melting furnaces in the founding of non-ferrous metals and alloys

and are very instructive from the point of view of the foundry foreman. Recent data as to the various non-ferrous alloys given in the book should help every designer and engineer in the line, to keep himself informed of the latest advances. The use of fluxes in the melting of non-ferrous alloys is a very interesting and intricate problem and the authors have given due consideration to this aspect. Some examples of difficult design of castings make the book very useful.

During the past 15 years or so, the aircraft industry has been responsible for the development of light and strong alloys containing aluminium and the authors have taken care to deal with this subject in sufficient detail. The chapter on magnesium alloys is instructive.

As the authors remark, books on foundry practice, especially of the non-ferrous type, where recent years have seen very great advances, are very few and the present one, written with great care will be very valuable to persons engaged in non-ferrous foundry practice. K. B. K. R.

This Strange World. By A. E. Trueman. (The Scientific Book Club, London), 1940. Pp. xiv + 240. Price 3*sh.* for members.

Each month, the "Scientific Book Club" brings to its members, as claimed in its prospectus, the fascinating story of the march of modern sciences told in thoroughly dependable books by the front-rank scientific writers of our time. One of such recent issues, dealing with the science of the earth, forms the book, *This Strange World*, by Prof. Trueman.

This Strange World, while in no way claiming to be a regular introductory text-book on Geology, gives a delightful outline of what that branch of Science is after, what it has achieved so far and what the problems are with which it is concerned at present. It includes, though, enough introductory matter to make it intelligible to a reader with no previous knowledge of Geology. Very few unfamiliar names and technical terms are introduced in the book and the reader is not pestered with unnecessary details relating to those branches of Geology which deal with fossils, and the study of rocks and their structures.

Indicating the several views which have been held, from time to time,—on the antiquity of the earth, its origin and subsequent changes and similar other particulars—the author gives a short account of the history of the science in Chapter I; and in the next chapter he describes briefly the nature of materials of which the earth's crust is composed,—the sedimentary rocks and their mode of formation and arrangement, and the igneous and metamorphic rocks, their origin and distribution. Furnishing a brief account of the Geological History of Great Britain in Chapter III, in the next eight chapters, the author gives a lucid summary of the results of all recent investigations, on every important problem, relating to the earth science, which are now engaging the attention of geologists, all over the world. The account includes the latest researches on the age of the earth; the conditions of its interior; the nature and mode of origin of earthquakes; the application of geophysical methods of investigation relating to earth structure; the origin of mountain ranges; isostacy; past climates and ice ages; and the burning question relating to continental drifts and oceanic basins. In the final chapter, the author gives an interesting account of how the influence of environment on the mankind, led the pre-historic man to his searching for stones, for his primitive implements; and his later descendants, with their advance in civilisation, to the search for other material like suitable soils for cultivation; and to the search for water, mineral oils and various minerals, etc., required for their purpose.

From first to last, *This Strange World* forms a fascinating reading and, contributed by an eminent geologist, it has all the impress of an authoritative account of our present knowledge on various problems of the science of the earth, which are dealt with in this delightful book. The book contains several illustrations and its general get-up is very good. The educated lay-readers will find the book very instructive and interesting, and even those who have studied, or are studying, Geology will be considerably benefited by a careful glance through its pages. B. Rama Rao.

The Rice Problem in India. By W. R. Aykroyd, B. G. Krishnan, R. Passmore and A. R. Sundararajan. (Indian Medical Research Memoirs No. 32. Thacker Spink & Co., Ltd., Calcutta), January 1940. Pp. 84. Price Rs. 3–8–0 or 5*sh.*

The publication deals with the nutritional, commercial and economic aspects of the Rice Problem in India. The authors have

presented data concerning the production and consumption of rice in India and have examined the proximate nutritive principles in rice and the changes brought about by parboiling and milling, particular attention being given to the changes in vitamin B_1. The ætiology and endemicity of *beri-beri* and the human requirements of vitamin B_1 are discussed, and the results of experiments carried out with rice diets in order to discover the most important defects of such diets and the means of improving them have been furnished. An interesting chapter on the economic and social sides of the rice problem studied by means of questionnaires and field enquiries has been provided and the *Memoir* concludes with a general summary of the entire problem.

Attention is drawn to the fact that milled rice is poorer than unmilled rice in the most important constituents, *e.g.*, vitamin B_1 or nicotinic acid and that their loss in milling is mitigated when rice is parboiled. Based on the Williams-Spies standard that the ratio, vitamin B_1 : calorific value of food should be at least 0·25 to prevent the occurrence of *beri-beri*, the authors are of opinion that rice, to afford protection against *beri-beri*, must have 1·4 to 1·7 micro-gram per gram of vitamin B_1. Nearly all samples of home-pounded or parboiled rice examined are above this minimum. On the other hand, all samples of raw milled rice are deficient in this respect.

And yet over 70 per cent. of the rice-eating population of the Madras Presidency consume machine-milled rice; elsewhere in Bengal, Assam, Bihar, Orissa, U.P., and Hyderabad, the percentage is less. From the results of a questionnaire issued, it is revealed that a false sense of economy has been the chief cause for the milled-rice habit. Actually, home-pounded rice does not entail greater expenditure than the machine-milled product. Besides, bulk for bulk, unpolished, cooked rice has more solid matter and can provide greater sustenance than polished rice.

On the subject of legislative action to prevent further erection of rice-mills or to do away with existing mills, the authors are emphatic that this cannot be recommended because "historically, attempts to encourage handicrafts at the expense of machinery have rarely been successful". On the other hand, the production of *highly* milled *raw* rice can, they consider, be prohibited by legislation. Under-milled or 'once-polished' rice is considered satisfactory in this respect. The number of large mills in South India, where alone such 'once-polished' rice can be produced are, according to the figures given by the authors, only about 550. Over 86 per cent. of the total number of rice mills are *small* mills and it is these small mills that have spread into rural areas and, in these, it is not possible to have any controlled polishing such as is advocated by the authors. This would obviously necessitate the establishment of suitable milling standards.

The authors are not in favour of taxing imported rice as they fear that "this might be at the expense of the very poorest population groups". The authors are of the opinion that the agricultural research worker should chiefly aim at the production of high-yielding strains and that he "need not concern himself with trying to change their composition". This is, no doubt, based on the finding that rice is of no importance as a source of protein in the diet.

The authors state in this connection that an improvement in food value can be more easily achieved by preventing the losses occurring during milling and preparation.

Among the suggested practical ways of improving the poor rice-eater's diet are the partial substitution of rice by one of the millets, particularly *ragi* and the increased use of pulses, milk, calcium salts and green and leafy vegetables. The use of skimmed milk powder or of calcium lactate is especially emphasized, but it would be infinitely better for us to turn our efforts at improving the country's milk supply and making milk a commodity within the reach of every purse.

The *Memoir*, on the whole, presents the results of a planned investigation into the problem of rice, its nutritional value, the defects of the rice-eater's diet and some practical methods of overcoming them. Not the least interesting and informative part of this enquiry is the chapter on the economic and sociological causes leading to the increasing displacement of hand-hulled or home-pounded rice by the machine-milled product.

A. SREENIVASAN.

Progress of Education in India, 1932-37. By John Sargent. (In two Volumes.) 1940. Price: Vol. I, Pp. 285, Rs. 3–2–0; Vol. II, Pp. 269, Rs. 4–4–0.

This publication, which is the eleventh quinquennial review of the progress of

education in India, is one which is familiar to all educationists and public men who desire to be posted up with the latest authoritative information in this field. The Report deals with the period of five years ending March 1937, and consists of two volumes. The first volume contains certain general observations on the main features of educational development during this period, followed by chapters on administrative arrangements, university, secondary and primary education, education of girls and women, professional and vocational education, and lastly, education of certain special classes and communities. The second volume is one of statistics. The figures have been collected with much care and labour, and the tables are intelligently presented.

There can be no question as to the utility of this quinquennial survey. It provides us with a means of understanding and evaluating the progress of education in this country over a convenient unit of time. The Hartog Report of 1929 was long, and perhaps even now, considered as the most comprehensive and valuable official document on educational matters. But much water has flowed under the bridge since that Report first appeared. It is therefore important that we should have an authoritative summing up of the educational situation from time to time, such as the one provided in the publication under review. Unfortunately, however, the Report has appeared three years after the quinquennium with which it deals; and in spite of the explanation offered in the Preface for this inordinate delay, one would wish that the work had been expedited.

The Report throws much light upon many of the problems which are now agitating the minds of educationists and others. At the very outset it refers to a criticism which attacks the very foundations of the Indian educational system namely, that it does not satisfy the needs of the people; that it lays too much stress upon literary studies without developing the practical side. In this connection reference is made to the Abbott-Wood Report and the Sapru Report both of which had suggested certain suitable modifications in the present system.

Educational expenditure, which had been adversely affected by financial stringency, showed a tendency towards recovery during the quinquennium. Nevertheless, education as a provincial transferred subject, under the charge of Indian ministers, has not appreciably prospered for lack of funds. Nor has the devolution of responsibility upon local bodies, for the lower grades of education, been more successful.

The universities seem to have developed in all directions, but still, the remark must be made that their contribution to national culture and material well-being may be considerably increased. The reorganization of secondary schools, so as to weed out the unsuitables and redirect their training into practical channels, is still an unsolved problem on the whole. So also is the problem of providing an appropriate atmosphere for those just entering upon their college studies. In regard to the adoption of Indian languages as media of instruction in the high school and above, consensus of opinion among universities seems to be in general favour, although practice lags far behind theory in this matter.

Primary education has made very little headway during the quinquennium. It is always the old story of wastage and lack of funds. Free and compulsory primary education on a nationwide scale is still a long way off. Certain attempts, however, have been made to recast the curriculum of the existing primary schools and to lengthen the period of instruction in them. The education of girls and women shows some improvement, but this has been largely in higher institutions of learning. Moreover, no substantial attempt has been made to devise a separate curriculum for the fair sex more in accordance with its peculiar needs. In regard to the professional qualifications of teachers much advance has been made, but the rate of this advance has not been uniform throughout India. The education of Muslims shows rapid growth. The school-going population in that community has nearly doubled itself during the past two decades. The education of the depressed classes seems to be well under way, and larger numbers of these children are being admitted into the ordinary schools.

To an educationist who looks for rapid and all-round progress in the education of this country the Report must be very depressing reading on the whole. There are few bright spots; and one is tempted to think that if the progress is as slow as this, there is hardly any need for a quinquennial auditing of it.

D. S. Gordon.

THE CHEMICAL CONSTITUTION OF NATURAL FATS

The Chemical Constitution of Natural Fats. By T. P. Hilditch. (Chapman & Hall, Ltd., London), 1940. Pp. xi + 438. Price 35*sh.* net.

WORKERS on the technical and biochemical aspects of the fats will already be acquainted with the fruitful results which have come from Professor Hilditch's school of research at Liverpool, represented by over a hundred papers from his laboratory during the past fifteen years, and they will keenly welcome his new book on this group of natural substances.

It is fitting at this stage to look back to the establishment of the Campbell Brown Professorship at Liverpool University in 1926, and the reviewer cannot do better than quote Dr. E. F. Armstrong's introduction to Professor Hilditch's earlier work *"Fats and Waxes"* (1927):

"In Liverpool, thanks to the generosity of one of its most prominent Professors of Chemistry, the late J. Campbell Brown, F.R.S., there has been established recently a Professorship in Industrial Chemistry, with special reference to Oils and Fats, to which Dr. T. P. Hilditch has been elected. In my opinion, not only is the choice of subject highly appropriate itself, but, further, no better geographical situation for a Chair of Research in relation to the industry in question could have been chosen. Liverpool as a port ranks high in the import of oil-bearing seeds and fats ......; a large group of industries based on bulky materials brought from overseas are all grouped round the port of entry to minimize transport; industries indeed which in many cases manufacture largely for export and pay for their raw materials by the manufactured goods which they send away from the same port.

The industries mentioned all have this in common, a need of precise and complete knowledge of the materials they use: in this case, the fats.

The scientific problems in such a field cannot profitably be solved by individual and isolated effort—they require mass attack by the whole staff of a research school, working to a definite programme during a number of years, before any real measure of success can be obtained. The experimental difficulties are considerable and a special manipulative technique has to be acquired."

Seldom can there have been so close a correspondence between initial aims and ultimate achievements as that attained by Professor Hilditch's research school.

Apart from technology, the chemistry of the fats had been a strangely neglected field. Indeed from the time that Chevreul established the fundamental nature of fats as compounds of glycerol with fatty acids, there was little essential development for about a century. Chevreul's collected work *"Recherches chimiques sur les Corps Gras d'Origine animale"* appeared in 1823. In Chapter V of the second part of his Book V Chevreul had already considered the quantitative aspect of alkali saponification, this chapter being headed *"De la quantité de graisse qu'un poids donné de potasse peut saponifier"*. It is all the more curious that not for nearly another sixty years was the chemical analysis of fats put on a really quantitative basis. It was early apparent that elementary analysis afforded little information since the carbon and hydrogen contents of most fats are similar.

A text-book of 1864, T. Chateau's *"Guide pratique de la Connaissance et de l' Exploitation des Corps Gras industriels"* may be taken as typical of the later years of this period. The analytical section refers to the determination of density (with a considerable variety of "oleometers"); an electric "diagnometer" based on conductivity measurements; the rise in temperature when different fats are mixed with sulphuric acid (the Maumené thermal value, which still finds a limited technical application), and an amazing variety of colour tests. Saponification is referred to as a possible method of quantitative examination. Trials are described of a large number of reagents including iodine solutions and it is clear that more or less settled procedures emerged later out of a considerable welter of empiricism.

There followed a period during which technical fat analysis developed fairly satisfactory standard methods for such purposes as the detection of adulteration of industrial fats, the determination of quality, and the assessment of potential raw materials. The two fundamental "characteristics", Saponification value (Köttstorfer, 1879) and Iodine value (Hübl, 1884) may be regarded as roughly dating the beginning of this period. Development of suitable instruments added the refractometer to the service of industry, and methods for special purposes such as those of Reichert, Meissl, Polenské, and Kirschner came into use.

The mass of literature which arose round these technical methods may conveniently be surveyed in the pages of J. Lewkowitsch's

well-known *"Chemical Technology and Analysis of Oils, Fats and Waxes"* (6th Edition, 1921), which may in fact be regarded as an epitome of fat chemistry before what the reviewer would term the "Hilditch era".

In general it may be said that the "characteristics" determined by such methods, developed mainly for technical purposes, represent a summation of the properties of the constituents of a fat under examination, and do not provide any information on the proportion of individual constituents. From this generalization may be excepted Kaufmann's thiocyanometric method (1925), and to some extent the Hexabromide value, and the Elaidin transformation which Professor Hilditch himself has placed on a semi-quantitative basis.

The problem of investigating the chemical constituents of a fat falls into two parts, the determination of the constituent fatty acids and of the manner in which these are combined with glycerol.

The first part of the problem had been attacked from time to time, for example by procedures involving the fractional crystallization of magnesium and other salts. These methods were tedious and only successful to a limited extent. The fractional distillation of methyl or ethyl esters was used by Haller (1906) and others. Professor Hilditch has adopted this method as a standard procedure, and has demonstrated that it is capable of giving reproducible results with an accuracy of about one per cent. Preliminary separation of the mixed fatty acids into saturated and unsaturated by Twitchell's method is advised, as well as a partial separation of lower acids in such cases as butter fat. The full experimental details which Professor Hilditch gives of the procedures he has found satisfactory will be especially welcomed by other workers.

A word may be added at this point on the important and often unconsidered role played in the development of chemistry by improvements in mechanical technique. The brilliant progress made in recent years in the field of vitamin and hormone research would hardly have been possible without improved microchemical methods. Similarly Professor Hilditch has pointed out that the development of ester-fractionation technique was greatly assisted by the availability of excellent electrically-driven rotary pumps which will maintain a steady vacuum for hours of running.

The second part of the problem—that of determining glyceride structure—had been attacked by physical methods prior to 1927. The main lines of attack were the fractional crystallization of fats, of brominated unsaturated fats, of hydrogenated fats; and the vacuum distillation of fats. Of this often extremely tedious work (involving, for example, in Bömer's studies, hundreds of crystallizations) an adequate account is given in the book under review, and Professor Hilditch sums it up with the observation that "the results were almost wholly qualitative in character .... nevertheless they are sufficient to demonstrate conclusively that seed fats are mixtures of mixed triglycerides, and that the occurrence of simple triglycerides is quite exceptional."

The modern methods of investigation developed particularly by Professor Hilditch need not be detailed here. The reader is referred to the book itself. Suffice it to say that these methods have proved capable of giving a fairly detailed picture of the major glyceride components of a variety of fats.

The emphasis here laid on the work of the Liverpool School is natural in a review of Professor Hilditch's book; this is not to discount the value of the data which has accumulated during the last fifteen years from other sources, of which may be mentioned the associates of Dr. G. S. Jamieson in the United States, Japanese workers on fish fats, the Dutch school at Delft, and various German investigators. Professor Hilditch includes in his book only those fats whose component acids have been adequately defined by modern methods; about 420 fats from plant species, about 80 fats from land animals, and about 100 fats of aquatic origin are mentioned. The number of fats whose glyceride structures have been at all satisfactorily defined is of course much smaller. The account which Professor Hilditch contributed to Schönfeld's *"Chemie und Technologie der Fette und Fettprodukte"* (Bd. I, 1936) has here been brought up to date to include data published to the end of 1938. Some 1939 publications also receive notice.

The available material has been sufficient to indicate the existence of a close connection between the component acids in a fat and its biological source. The fats of the most primitive organisms are usually made up of a very complex mixture of fatty acids, whilst as evolutionary development

has proceeded, the major component acids have progressively become fewer in number. In the depot fats of the higher animals, oleic, palmitic and stearic acids are the major components.

In a number of plant families, specific fatty acids are often found such as petroselinic (associated with the *Umbelliferæ*) and erucic (with the *Cruciferæ*).

Professor Hilditch has, on account of these associations, adopted a biological classification of the fats in his book. Similar biological relationships have attracted much attention in other fields, notably those of the terpenes and of the alkaloids, and it is of interest to refer to certain features of the latter group of compounds. Whilst there are such obvious chemical relationships as those of the *Papaveraceæ* group of alkaloids, there is an increasing number of anomalies in distribution. Sparteine is a case in point; this, formerly regarded as a typical alkaloid of the *Papilionaceæ*, has been recorded in association with piperidine type alkaloids from *Anabasis aphylla* (*Chenopodiaceæ*) and also with chelidonine in *Chelidonium majus* (*Papaveraceæ*). Professor Hilditch refers to the occurrence of eleostearic acid in the three distinct families *Euphorbiaceæ*, *Rosaceæ* and *Cucurbitaceæ*, and similar apparent anomalies could be quoted among the terpenes.

T. A. Henry in the latest (1939) edition of "*The Plant Alkaloids*" remarks that "Nature does not manage the production of alkaloids to meet the requirements of the chemical systematist, or, indeed, those of his botanical equivalent", and in the field of the fats, the interesting biological relationships already apparent should not be too rigidly interpreted.

With the existing data in all these fields, only a very small sample of the whole biological kingdom is open for inspection, and that a very uneven sample. The investigation of more animal fats is obviously desirable, since for these much less reliable data are available than for the vegetable fats.

Much earlier work on the fats has been valueless by reason of faulty identification of raw material. There is a necessity to refer to systematists questions of botanical and zoological classification. The not infrequent changes of nomenclature sometimes causes embarrassment to the chemist. The *Madhuca* fats form an illuminating example, and to the chemist it seems unfortunate that the rules of nomenclature could not have been modified in such a case, since these fats had for a long time been known to the technical world under the name *Bassia*.

Professor Hilditch has obviously taken care to ensure the correctness of the identification of the fats detailed in his book, though the reviewer has noticed at least one minor duplication. *Litsea zeylanica*, quoted (in a supplementary list) from Jumelle's "*Les Huiles Végétales*" (1921) is synonymous with *Neolitsea involucrata* (Lamk.), Merrill, a Ceylon sample of which was investigated in detail by Gunde and Hilditch last year.

Where systematists themselves disagree, chemists must hope for the best. There is a temptation to expect that the chemist may soon be able to come to the assistance of the botanist by supplementing morphological with chemical characteristics. The cases quoted of sparteine and of elæostearic acid show, however, the danger of making deductions on the basis of similarity of chemical constituents.

It is not the least of the merits of Professor Hilditch's book that it will give a tremendous impetus to future research. In fact the reviewer is acquainted with few monographs of recent years which perform so well this essential duty of stimulating further work, and so clearly indicates promising lines of study. The field opened up is a wide one, and the subject is in an active state of development. Professor Hilditch's enthusiasm has inspired workers all over the world, including many in India and Ceylon, where a wealth of raw material, both animal and vegetable, awaits investigation.

There is no doubt that the present work represents in the chemical history of the fats a milestone as notable as Chevreul's "*Récherches*"; but unlike that classic work it is improbable that it will be followed by a comparatively sterile period of sixty years. The reviewer may be permitted to hope that, in spite of the inevitable dislocation of research by war, progress in the next decade or so will be even more rapid, and that in 1950 Professor Hilditch will be still so ably reporting it.

It remains to congratulate the publisher on the excellent printing, especially of the extensive tabulated data, and on the general get-up of the book. If there are any serious typographical defects the reviewer has failed to find them.

R. CHILD.

FISH STATISTICS

THE importance of fisheries to an agricultural country like India cannot be too sufficiently emphasised. Only a look at many of the common people is sufficient to gauge the extent of mal-nourishment prevalent in India, as most of the poorer classes are rice-eaters, and this diet consisting as it does of almost pure starch is very deficient in proteins and nitrogenous material. On the other hand, rice and fish together make a well-balanced diet. India needs more and more of fish, and fortunately the very rich finny population of our seas is available almost at our doors for scientific exploitation and for well-planned utilisation. Another very important aspect is that a well-developed fishery is an asset to a nation and means more national wealth and a race of brave and adventurous seamen.

The publication of "Fish Statistics" (Reports Nos. II, III and IV of 1937, *Madras Fisheries Bulletin*, Vol. 27) is an attempt in the right direction. The statistics refer to the west coast of Madras Presidency representing a coast-line of 240 miles. The data have been collected by the officers-in-charge of about 58 Fish-Curing Yards distributed on this coast. Each report consists of 9 statements and gives particulars regarding the quantities of fish landed with values; the fishing gear used in the various localities; the constituents of the hauls made with different implements; the places of abundance of the different types of fishes at different seasons; the range of prices in the various localities; and a statement showing the distribution (according to depth) of the shoals of 6 important varieties [Oil Sardine, Mackerel, Cat-fish, Silver-bellies, Chamban (the Goggler) and Sole]. The report for 1930–31 contains 3 additional statements relating to the census of the fisher-folk and their craft and tackle in the South Kanara and in the Malabar Districts. A compilation of fishery statistics on the above model for the whole of India, for both marine and fresh-water fishes, would be extremely useful for the future development of fisheries in the country.

Statistical publications have more than an academic interest. To focus attention on any undesirable state of affairs or to urge Government to institute ameliorative or remedial measures, no better argument can be adduced than reliable statistical data. It is, however, necessary that such data should be published immediately when the facts they represent are fresh, and while the conclusions deduced therefrom can be put to some practical use. The publication of the *Bulletin* under review has unfortunately been unduly delayed. In Statement No. XI relating to the statistics for the year 1930–31, there is a foot-note which states:—"Suspected to be a wrong figure. It could not be corrected owing to lapse of time." This remark is perhaps typical of the difficulties that confront a statistician when asked to tabulate data collected years ago. It is apparent that the data collected were shelved for some reason or other, and were examined after several years when the situation had completely changed making it impossible to check the statements. It is to be hoped that hereafter statistics relating to any one year would be published as soon as possible during the succeeding year.

The catches landed show a good deal of fluctuation. The fishes of economic importance are again the much despised small bony varieties. It was pointed out in the statistical report for 1925–26 that "the fishermen would be hardly affected and the fishing industry in India will suffer scarcely a loss .... should the highly-priced table-fish be exterminated, whereas the loss of any of the smaller fish .... will inflict an irreparable damage to the fisheries and fishermen" (p. 7). This point is again very clearly brought out in the three reports now published. Dr. H. T. Sorley in his report on the Fisheries of the Bombay Presidency states that "the small inferior and immature bony fishes are a very important part of the fresh fish supply of the Bombay Presidency" (p. 106). Though large hauls are made, these small and cheap fishes never reach the inland markets except as cured fish. People in the inland would certainly prefer fresh sea-fish to salted or sun-dried varieties, if the quality is good and price not excessive. If cold storage and efficient transport facilities are developed, the catch now cured (very often converted into manure for want of a market) could be sent into the inland area where a demand for fresh fish can easily be created. It is useless to expect the so-called "table-fishes" to sell cheaply in the

inland markets or to satisfy with the limited quantities of these fish the demands of the potential fish-eating population. Whenever cold storage is spoken of, people only think about table-fishes, but publication of statistics like the report under review should open the eyes of capitalists and business people to the possibilities of developing a very virgin field; such a development would in addition to assuring a handsome return to the business people and the fishermen mean better and more balanced food for the poorer classes in the inland areas.

V. P. A.

GALACTIC DYNAMICS*

Polytropic Gaseous Configuration

A POLYTROPIC change of gaseous matter is defined to be a quasi-statical change of state brought about in such a way that specific heat remains constant during the entire process. A quasi-statical change is conducted infinitely slowly so that the state of the system at any instant may be regarded as that of equilibrium. It is found that if a gaseous configuration is polytropic the law $p = k\rho^{1+\frac{1}{n}}$ is satisfied where k and n are disposable constants, p being the pressure and ρ the density at any point of the gaseous mass. In the absence of any disturbing factors, an isolated non-rotating mass of gas will settle down into a spherical distribution. If the gaseous mass rotates with a small angular velocity ω the configuration will become slightly oblate. Assuming that ω is small and uniform throughout the mass, Milne, Ziepal, and Chandra Sekhar have tried to specify completely gaseous configurations for various polytropic models. P. L. Bhatnagar has examined the case of a rotating gaseous model for which ω, though small, is not uniform throughout but varies according to a certain law depending on the distance from the axis of rotation.

Chandra Sekhar has also considered the double star problem. He has found that the distortion of a "double-star" component is the same as if it is rotating like a rigid body about its own axis with the angular velocity ω and then tidally influenced by the other component at a distance r from its centre of gravity, the two effects being simply added.

In the case of eclipsing binaries, all the necessary data are available from observation, and it is found that the density condensations of these stars as calculated from Chandra Sekhar's theory come out to be rather higher than those obtained from direct interpretation of observed facts.

Kopal has attacked the problem of rotating gaseous configurations by an essentially different method, the starting point of his investigations being Clairaut's original papers which were published more than a century ago.

Eddington has discussed the case of non-uniform polytropic index n. He maintains that "all possible spherical distribution of matter can be described by a varying polytropic index n", which he has defined by the equation

$$1 + \frac{1}{n} = \frac{d \log p}{d \log \rho}$$

where p is the pressure and ρ the density at any point of the configuration.

Spiral Nebulæ

Telescopes reveal that about 97 per cent. of extra-galactic nebulæ have regular forms ranging from globular nebulæ and ellipsoidal figures to a series of spirals with open arms. These nebulæ can be divided into two main classes, *viz.*, elliptical nebulæ and spiral nebulæ including both normal and barred spirals. Several interesting theories have been suggested to account for the shapes of spiral nebulæ, but none of them has yet been able to give a satisfactory explanation for the formation of spiral arms. It is believed that in the outer regions of the equatorial extensions of the spiral nebulæ condensations in the shape of star clouds were first formed.

Jeans has examined the series of configurations which would be assumed, under increasing rates of rotation, by a quantity of matter consisting of an atmosphere of negligible mass surrounding a massive point nucleus. If $\bar{\rho}$ is the mean density of all matter inside the bounding surface of the configuration, and if $\bar{\rho}$ is greater than its critical value ρ_0 given by $\frac{\omega^2}{2\pi\gamma\rho_0} = 0{\cdot}36$, it is possible that surplus matter will stream out in the equatorial plane. The main defect in Jeans' theory is that he discards the possibility of star clouds existing in his model for nebular configuration, and this is not borne out by observation. A short time scale for the age of stars situated in the spiral arms of the nebulæ will solve many difficulties, but Jeans' theory requires that the time scale for the age of such stars should be long.

Brown has assumed that before the arms of a spiral nebula were formed it had been a highly flattened homogeneous ellipsoid of revolution. Some galaxies passing rather close to the homogeneous nebula might have caused perturbations which brought about minor variations in its density and ultimately led to the formation of spiral arms. To make allowance for the minor variations in the density, Brown superposes rather arbitrarily on the uniform density a small additional density consisting of a periodic term. He thus gets a spiral form and suggests that the spiral formation is a periodic phenomenon. There is no evidence, as yet, which supports the above suggestion about periodicity.

* Summary of three lectures on "Galactic Dynamics" delivered by Professor A. C. Banerji (Allahabad University), under the auspices of the Lucknow University, February 15–17, 1940.

Vogt and Lambrecht have assumed that almost the whole of the mass of the spiral nebula is concentrated in the nucleus, and that there is a cosmic repulsive force proportional to the distance from the centre of the nucleus in addition to the gravitational force of attraction. It may be mentioned here that there is no justification for assuming a "Cosmic Force" of repulsion in Classical Mathematics. It is also not reasonable to suppose that the whole mass of the configuration is concentrated in the nucleus. Moreover Vogt's theory cannot give any cogent reason for the existence of two arms of a spiral nebula. Lambrecht attributes the formation of the pair of arms to encounters.

Lindblad, in his earlier investigations, has assumed a configuration which consists of a spheroidal galaxy of stars of uniform density having a small condensed nucleus at the centre. Any tidal action on it will produce perturbations and may lead to spiral formation. Lindblad has worked out the condition necessary for such formation of spiral arms. He has found that if the mass of the nucleus is small, there is greater possibility for formation of these arms.

From spectrographical observations we find that there is a fairly uniform angular velocity of rotation in the central part of a nebular configuration, and in the outer less dense regions the angular speed is far less than in the central part. Lindblad, in his later investigations, suggests that the rapid decrease in the speed of rotation as we proceed outwards from the central core may produce instability and cause the formation of spiral structure.

Lindblad maintains that for the formation of the observed spiral arms, considerable flattening of the spheroidal configuration corresponding to the meridional eccentricity 0·96 at least, is necessary. He has shewn that in the outer regions of the configuration, local condensations are likely to form. He suggests that if there be an encounter between two such condensations near the edge of the configuration, one of the condensations being ejected out of the system may depart in a spiral orbit. Recent investigations by Plaskett and Pearce about our local galaxy tend to show that "the whole galactic system is immersed in a gaseous substratum consisting of atoms of various elements ... The separate atoms, while obeying gas laws, participate in a rotational movement around a distant central mass in galactic longitude 325°."

"The observed rotational accleration seems to be same as that for the stars so that the atoms are not subjected to any appreciable radiation pressure from the central mass."

Depending on the above conclusions, Banerji, Nizamuddin, and Bhatnagar have assumed a model which consists of a rotating spheroidal central mass of finite dimensions and uniform density surrounded by a spheroidal structure of rotating compressible gas having variable density. They have also investigated the condition necessary for the formation of spiral arms. The size of the central mass is taken to be small compared to that of the outer boundary of the gaseous structure. If the angular velocity is small, the outer boundary of the gaseous configuration would differ little from a spheroid.

They have found that for spiral formation, the equatorial diameter of the central nucleus in the case of our Galactic System cannot be greater than 35 parsecs and in the case of Andromeda nebula cannot be greater than 600 parsecs.

Eddington's theoretical researches, and Plaskett and Pearce's observational investigations show that interstellar space (within the confines of our Galactic System) is not empty but is filled with a highly rarefied gas of substantially *uniform density*. Bearing this point in mind, Banerji has investigated the condition necessary for the formation of spiral arms in the equatorial plane of a rotating gaseous configuration of uniform density which surrounds a spheroidal homogeneous mass of incompressible material of relatively small size. It is evident that the density of the gaseous structure can only be uniform if the angular velocity ω is variable and satisfies a certain relation. Banerji has investigated this relation and has obtained the condition necessary for the spiral formation in a suitable form.

It is found that for spiral formation the equatorial diameter of the inner core in the case of our Galactic System must be less than 270 parsecs, and in the case of Andromeda nebula must be less than 560 parsecs.

The Origin of the Solar System

The planetesimal theory of Chamberlin and Moulton and the tidal theory of Jeans and Jeffreys regarding the origin of the solar system undoubtedly possess several distinct advantages, but they are also open to certain grave objections. In both these theories the sun and a passing star narrowly missed each other. It seems to be very improbable, if not almost impossible, that so much angular momentum as is observed in the planets could be put into the planetary matter when it was ejected from the sun during its (sun's) encounter with another star. Moreover, the formation and arrangement of satellites cannot also be satisfactorily explained by the above theories.

Russell has considered a number of new lines of attack on this problem. One of the theories, *viz.*, the sun might have been a member of a binary star having a companion much smaller than itself and that a collision between the companion and a passing star broke the former into fragments from which the present planets were formed, was examined by Russell critically. He abandons this theory as unpromising in view of the fact that it cannot explain satisfactorily how the companion of the sun was got rid of and how the terrestrial planets were ultimately formed. On the other hand, Lyttleton maintains that as the result of a close tidal encounter of a component of a double-star with an intruding star of average mass and velocity (at infinity) the binary system can be disrupted and all the three stars can subsequently escape from each other. He further asserts that under favourable conditions a portion of the tidal or planetary ribbon can be captured by the non-colliding component of

the binary system and ultimately condensed into planets. He also suggests that "later encounters between pairs of planets while in the liquid state give promise of an explanation of the formation of satellites". Luyten and Hill have criticised Lyttleton's theory and have pointed out that the two colliding stars would retain about 94 per cent. of the length of the planetary ribbon and so only 6 per cent. of the length of the filament would become available for possible capture by the sun (the non-colliding component of the binary system) and subsequent formation into planets. Luyten has further pointed out that in order to capture even a part of the filament the sun must have been moving parallel to the filament for some considerable time and must itself have suffered a close approach or collision with the intruder. In the above case if the intruding start is more massive, the sun itself would be captured by it.

In a recent paper, Bhatnagar has shewn mathematically, that if there was collision between the sun's companion and a passing star, the distance between the sun and its companion would have been so much reduced that a second collision between the components of the binary system as well as between them and the intruder could not have been avoided. In the case of close approach between two stars without actual collision, Bhatnagar has calculated possible lengths of maximum tidal elongations and shewn conclusively that even at the instant of closest approach, no planetary ribbon joining the two stars is possible. It is evident therefore that so far no satisfactory theory about the origin of planets and satellites has yet been developed mathematically.

MANUFACTURE OF SCIENTIFIC INSTRUMENTS

BY

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THE manufacture of scientific instruments is an item of national importance, inasmuch as it occupies an eminent place in our scientific and engineering developments and corresponds to the manufacture of heavy chemicals in all chemical and allied industries. There is, of course, this important and obvious difference that the number of different heavy chemicals is small while the number of different kinds of scientific instruments is almost innumerable. The name *scientific instrument* indicates a classification suggesting that it represents a type of instruments employed in scientific pursuits in educational, industrial and research laboratories. Instruments employed in public utility services, like the telegraph, the telephone, motor cars, aeroplanes, air conditioners, etc., are also invariably scientific although they are not necessarily used in scientific institutions.

The present position as regards scientific instruments in this country is such that they are finding more and more employment in all spheres of life. With the spread of education, leading to higher standard of living and rapid industrial developments, the employment of scientific instruments is increasing rapidly. This is probably a good sign, suggesting progress, but unluckily the development is one-sided and somewhat unreliable, unless India can safely depend on manufacturing all the requisite instruments in this country and out of local raw materials. There have been and there are, even now, some enterprising concerns that endeavour to manufacture scientific instruments but the sum total of all such attempts is yet only a drop in the ocean. It would not be an exaggeration to say that the demand on scientific instruments and appliances is almost wholly met from articles of foreign manufacture.

The scientific instruments industry must occupy a peculiar position. It may not catch the imagination of the lay public, but it must be the special care of the industrialists. educationists and researchers, who should uniformly champion the cause of local manufacturers, because such a frame of mind alone can give proper encouragement to enterprising designers, inventers and mechanics. It should also be the anxiety of all industrial and scientific institutions to foster the spirit of depending, as far as possible, only on appliances of local manufacture.

There are already in existence about a score of manufacturers of scientific instruments in India, but most of them devote themselves to the construction of just those few articles that are usually employed in educational institutions. Their products are good and they serve a useful purpose, but the majority is still dependent on imported raw materials or ready-made components. In spite of this, the industry has made considerable progress. The passage through the assembly stage is unavoidable and yet very important; because it helps to train up workmen and develop confidence in their skill; it also gives the manufacturers time and opportunity to look about for local raw materials while the finished product, built out of foreign components, is becoming popular and attractive.

The other important question is as regards organisations which should control:

(i) the training and supply of skilled labour;
(ii) the testing and grading of scientific instruments; and
(iii) the marketing of the products.

Skilled labour for the various jobs in a scientific instrument maker's workshop is not easily available, and there is also no proper provision for training mechanics. Special faci-

lities may have to be provided for this purpose. It is also necessary to introduce, among the different manufacturers, the idea of specialisation at a certain stage. Each manufacturer makes all kinds of different instruments, with the result that the designers and the workmen have little chance of acquiring the necessary experience and skill to be able to produce articles of a definite quality. The purchaser, in spite of his anxiety to buy Indian-made articles, remains perplexed. It would, therefore, appear necessary to establish independent or State-controlled institutions which will be in a position to critically examine the different products of different makers and grade them properly. These institutions will also arrange to equip themselves with special expensive tools and precision standards which individual makers of scientific instruments can hardly be expected to afford and yet are required to employ.

The Universities and other public institutions which maintain large libraries will also have to widen the scope of their activities and endeavour to obtain literature bearing on the subject of the manufacture of scientific instruments, a subject which does not appear to have received much attention so far.

PROSPECTS OF HUMAN SURVIVAL

DR. KIRTLEY F. MATHER discussed the prospects of human survival in his Sigma Xi lecture delivered during the recent session of the *American Association for the Advancement of Science,* Ohio, 1940. On geological, palæontological and biological grounds, man will probably survive for at least some thousands of years. "Even if this present age is interglacial and not post-glacial, man's specific adaptability to extremes of climatic environment would enable him to survive. There is, however, one circumstance which militates against man's prolonged survival. This is the fact that in his conquest of the material world, which is the fundamental characteristic of his recent progress in civilization, man is using up his capital, such as oil, at a far higher rate than he is using his income, that is, the products of natural increase; and a further and even more alarming feature is that that capital expenditure is increasing progressively as the enjoyment of its amenities extends to the less sophisticated peoples. Hence, exhaustion of capital in possibly seventy years or less may seriously curtail man's future."—*Nature,* 1940, No. 3678, p. 663.

CENTENARIES

Ridson, Tristram (1580–1640)

TRISTRAM RIDSON, a British topographer, was born in a village near Terrington about 1580. He resided at Pembroke College for some years but left Oxford without a degree.

Ridson lived on intimate terms with his contemporary topographers and his *Chorographical description or survey of Devon* commenced in 1605 and completed in 1630 was a much used manuscript, till it was printed in 1714. Its value was such that it went through several editions till about a century ago. An index to this book was commenced in the *Transactions* of the Devonshire Association in 1894.

Ridson died in June 1640.

Duclaux, Pierre Emile (1840–1904)

PIERRE EMILE DUCLAUX, a French biochemist, was born at Aurillae June 24, 1840. Besides several papers he wrote more than half a dozen treatises of which his *Microbiologu* in four volumes is the most famous.

Duclaux was a friend and co-worker of Pasteur. He accompanied Pasteur to Milan when the latter visited the seeding establishment which had been named after himself. It was he that planned the *Annals* of the Pasteur Institute. Duclaux died in 1904.

Veitch, Henry James (1840–1924)

HENRY JAMES VEITCH, an English horticulturist was born at Exeter June 29, 1840. His father was himself horticulturist of his day. He was very keen in introducing new plants to cultivation. His firm were pioneers in orchid hybridisation. He was connected with the Royal Horticultural Society of which he ultimately became vice-president. He was awarded the Victoria Medal of honour in 1906 and was honoured by several other foreign learned societies. His two chief works are the *Manual of coniferæ* (1900) and the *Manual of orchidaceous plants* (1887–1894).

Veitch died at East Burnham Park July 6, 1924.

S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

The Poisonous Plants of India.—An important outcome of the Medicinal Plants and Food Poisons Inquiry, being carried on under the auspices of the Imperial Council of Agricultural Research, is the compilation of a comprehensive list of the poisonous plants of India by the officers in charge of the Inquiry. The list is now published together with a popular exposition of the various aspects of their nature and occurrence (R. N. Chopra and R. L. Badhwar, *Ind. J. Agr. Sci.*, 10, Part 1). It is the precursor of an exhaustive monograph now under preparation. The plants in the list are arranged according to the families and the botanical names of the different plants, the nature of the plant poison or other active principle, their specific method of action in the animal body, and other interesting details of information are appended. The compilation constitutes the most indispensable spadework for investigations of far-reaching value which, however, can be accomplished only in the course of a generation. Among the matters discussed or described may be mentioned the various chemical constituents responsible for the toxic effects, such as amines and alkaloids of different kinds, glucosides, both directly poisonous and cyanogenitic or saponin yielding ones, essential and volatile oils, toxalbumins and resins, bitters, phenolic compounds, etc. The factors affecting toxicity are briefly touched upon and the effect of drying in some cases and of cultivation in others which both bring about a loss of toxicity are referred to and the stage of growth is mentioned as perhaps the most important factor in determining the toxicity. Bacteria, algæ, and fungi lichens mosses and other cryptogamic plants which are plant poisons are also listed and described. As most of the plants referred to are principally cattle poisons this aspect of the question is gone into in detail and methods of preventing such cattle-poisoning are discussed. The indiscriminate importation of ornamental plants some of which are poisons and which grow luxuriantly in their new environment is deprecated and even legislation to prevent the importation of such plants may become necessary. Plants and materials which are normally regular food substances but which under some conditions may become poisonous are described and some important but little-known facts about these are indicated. The section on insect and fish poisons is perhaps the most interesting and certainly exhaustive. The economic aspect of their importance in furnishing cheap and abundant possible sources of insecticides for use in agriculture and in the control of malaria and other insect-borne diseases gives the list special value and a claim for priority of investigation. The work has certainly entailed a vast amount of painstaking inquiries, search and collaboration, and the *Monograph*, when it does appear, will be welcomed as a monumental publication.

A. K. Y.

* * *

An Improved Electric Hygrometer.—The psychrometer and hair hygrometer, commonly used for determining moisture content of air, are not well adapted where marked and sudden changes in humidity are encountered, such as in the measurement of upper air humidities by means of the radio sonde. F. W. Dunmore (*Journ. Res. Bureau of Standards*, 1939, 23, 701) has now described a type of electric hygrometer which better fulfils the above requirements. The unit consists of an 0·01-inch-wall aluminium tube coated with polystyrene resin and wound with bifilar winding comprising 20 turns (of each wire) per inch of No. 38 AWG bare palladuim wire. The unit is then coated with a thin film of partially hydrolyzed polyvinyl acetate with the addition of a small amount of lithium chloride, the amount depending upon the humidity range to be covered by the unit. The electric resistance of the film between the two coils is a function of humidity. Methods of construction, coating, aging, and using the units in both A.C. and D.C. circuits are given.

M. A. G.

* * *

Pantothenic Acid.—The synthesis of yet another vitamin by Doctors Stiller, Keresztesy and Finkelstein of the *Merck Research Laboratories*, has recently been announced. (*Science*, 1940, March 8). The vitamin has the chemical structure $HOCH_2C(CH_3)_2CH(OH)CO\,NHCH_2CH_2COOH$. Its synthesis has followed in the wake of its isolation in pure condition from natural sources. It belongs to the B group of vitamins and is identical with the chic anti-dermatitis factor.

* * *

The Myenteric Nerve-Plexus.—While the autonomic nervous system of higher vertebrates (chiefly mammals) has engaged the attention of workers from a long time, that in the lower chordates requires investigation. Kirtisinghe (*Quart. J. Micr. Sc.*, 1940, 81, 521) after investigating Amphioxus (fixation unknown), Scylliorhinus, Motella, Saccobranchus and Ophicephalus has come to some interesting conclusions. Auerbach's plexus is simple in Amphioxus and fish; the nerve cells are situated in the meshes. In Scylliorhinus, Dogiel's type II nerve cells predominate while in teleosts both type I and II occur. Synapses between the preganglionic fibres and enteric neurons and among the neurons themselves are described. No connection between Auerbach's plexus and 'interstitial cells' of Cajal are seen. The stellate ganglion cells of Amphioxus are to be compared with neurons of type I of higher forms.

* * *

The Resistance of Mealy-Bugs (Homoptera) to Parasitisation by Internal Hymenopterous Parasites, with special reference to Phagocytosis. It is concluded that host specificity, in so far as oviposition is concerned, depends upon the attractiveness of the hosts to the female adults and not upon the suitability of the hosts as media for the development of their progeny

(*Ann. Ent. Soc. Amer.*, 1939, 32, No. 1). Differences in the developmental rate of a parasite within different hosts, as well as the resistance of these hosts, may be due in part, to the favourability of the host fluids as nutriment. The unsuitability of a resistant or immune host as a developmental medium for a specific parasite may be due to something (Enzyme, etc.) lacking or possessed by the parasite, rather than something lacking or possessed by the host. Apparently the stimulus which initiates Phagocytosis of the parasite eggs in *Pseudococcus gahani*, is associated in some way with the development of the parasite larvæ within the eggs. There is some evidence, although, not conclusive, that phagocytosis of the parasite eggs in this species was initiated by chemical substances liberated about the time of hatching. Neither phagocytosis, character of surface of parasite, hosts inadequate as food, nor melanization alone, appears adequate to explain, how immunity is realised. The data presented are considered to show, that immunity is not necessarily accompanied by phagocytosis.

* * *

Survey of India.—The General Report of the Survey of India just issued, gives details of the survey operations of the ordinary field units, as well as, drawing, map publication and instrument manufacture along with an abstract of the Geodetic Report detailing scientific work done during the survey year, 1st October 1938 to 30th September 1939.

A summary of surveys done in each Province and State is given in abstracts II and III, details of these surveys being given in part 3. The Survey of India, primarily engaged in geodetic, topographical and geographical surveys, is now doing a fair amount of miscellaneous outside work on payment and also assists and advises Provincial Governments with local and settlement surveys when required.

Abstract III contains a resume of geodetic operations undertaken during the year. The usual magnetic, seismographic and meteorological observations were conducted. A start has been made to publish complete data pamphlets giving triangulation data, geodetic and topographical, and the first pamphlet of this new series is hoped to be issued in 1940. The tide tables of the Indian Ocean for 1940 for 67 ports were prepared and published in September 1939. At 42 new stations in Burma, observations to determine the force of gravity were made.

The publications of the Department for the year are given in Tables I, II and III in part 4, which also gives an idea of work done in revising existing maps and publication of special maps. Anodised aluminium, cellulose sprayed materials and a transparent plastic called *Perspex* were tried as substitutes for foil-mounted paper for fair-drawing. The expense of these materials may limit their use. Photo lettering has also been further developed.

During the year, there has been an increase in the sale of instruments and the range of scientific instruments manufactured and repaired. A new type of offset scale in plate glass, devised by Brigadier Lewis, has been constructed in the Mathematical Instrument Office, rendering plotting easy and rapid. The special "offset machine" constructed in the Mathematical Instrument Office has increased considerably the range to which accurate offsets can be taken. Offsets can be taken with accuracy on the forty feet to an inch scale to a range of about 150 feet. During the year, repairs to air-craft instruments necessitated the opening of a new section. The requisite test apparatus and wind tunnel are under construction.

Index Map A, at the end of the Report, shows the progress of modern Topographical Surveys and of compilations made by the Survey of India. Index Map B indicates the obsolescence of Modern Surveys. Index Maps C to G show the progress of publication to date of all standard series of modern maps.

An account of the different activities of the Survey of India during the year is embodied in the Report. C. Gopalakrishnan.

* * *

Prince of Wales Museum of Western India.—The reorganisation of the galleries in the archæological section, the acquisition of valuable exhibits to the various departments of the Museum, the publication of a handbook of the Indian Art Collections, the deputation of an officer of the Museum staff to join the Vernay-Cutting Expedition organised by the American Museum of Natural History, New York and the British Museum for surveying the mammals of the higher reaches of the Chindwin Valley, and the organisation of an Ornithological survey of Central India States, are a few of the activities recorded in the Annual Report of the Prince of Wales Museum for the year 1938–39.

With a view to extend the educational services of the Museum to the general public and school children the Trustees have proposed to the Government the necessity for employing guides on the establishment of the Museum. This proposal is receiving due consideration.

Among the notable additions to the Natural History Section, mention must be made of the casts of a saw-fish, 21 feet in length, which was caught in the fishing nets at Back Bay, and a whale-shark, a rare fish, caught by local fishermen 15 miles off Bombay. The important work of cataloguing and indexing the reference collections in the section was continued during the year and a number of valuable publications were issued. In spite of the unsatisfactory financial position, the Natural History Section has shown much activity; it is hoped that adequate funds will be provided by the Government to meet not only the costs of maintenance but also to enable the undertaking of developmental work.

* * *

Inter-University Board.—The Report of the activities of the Inter-University Board for the past year is of value to all those who are interested or engaged in higher education in this country. It indicates what action has been taken following the various resolutions passed by the Board at its ordinary meeting as well as at its annual conference.

Generally speaking, the questions discussed

at these gatherings refer either to matters of educational administration or to curriculum problems. In connection with the latter it is encouraging to note that Indian Universities no longer content themselves with providing instruction in the old stereotyped subjects but that they are trying to strike out new paths and expand their courses of study. Thus the Report contains suggestions for the introduction of such branches of knowledge as pharmacy, technology, military science, aeronautics, entomology, seismology and public administration. From the replies received it is seen that there is sometimes considerable difference of opinion—as well as non-expression of any opinion—among the universities. On certain other matters, however, there seems to be considerable agreement, as for instance, on the wider use of indigenous languages in higher education as media of instruction. D. S. GORDON.

* * *

Kodaikanal Observatory.—A further fall in solar activity is reported in the latest annual report (1939) of the Solar Observatory at Kodaikanal. Observing conditions were slightly more favourable for observations than in 1938.

The daily mean number of sun spots remained the same as in 1938. There was a decrease of 39 per cent. in the mean daily areas of calcium prominences and a decrease of nine per cent. in their mean daily numbers. A study of prominence areas was made to determine the possible influence of the earth on solar prominences.

Photographs of the sun on a scale of eight inches to the sun's diameter were obtained on 330 days and photographs in the lights emitted by calcium and hydrogen on the sun on 317 and 284 days respectively. Photographs showing solar prominences were taken on 305 days. Some of these photographs were supplied to Observatories at Greenwhich, Cambridge and Meudon.

The bright eruption on the sun on March 3 could be photographed in its successive stages. During the months of August and September, the sun showed unusual activity. These, as well as selected Fraunhofer lines, formed subjects of special study. A theoretical investigation on the mechanism of solar dark markings was also undertaken.

An amplifier to the photo-electric microphotometer at the Observatory was constructed and fitted up. The Observatory carried out the programme of the International Astronomical Union.

The Milne-Shaw seismograph recorded 193 earthquakes during 1939.

* * *

The Annual Report of the *International Tin Research and Development Council*, which has just reached us, gives a detailed summary of the progress in equipping its new laboratories in Middlesex, and the results achieved in the technical and commercial development of each of the main uses of tin. The Council has rendered valuable assistance to tin users in overcoming their difficulties and problems. Many of the enquiries related to the process of hot-tinning; new problems for the hot-tinner have arisen as a result of recent improvements in the methods of finishing steel. Among the Council's researches, which have reached a stage when the results could be developed on an industrial scale, mention may be made of hot-tinning, electro-deposition of pure tin and of copper-tin alloys, tin-rich bearing metals, tin oxide as an opacifier for vitreous enamels, and the action of small additions of tin in increasing the wear-resistance of cast iron.

* * *

A World Catalogue of Meteorites, the largest and most comprehensive of its kind yet published in any country, which should prove of use to those interested in these extra-terrestrial arrivals, has just been brought out as a *Memoir* by the Geological Survey of India. A special reference is made in the publication to the Indian falls and finds and to specimens exhibited in the Indian Museum, Calcutta.

The collection of meteorites of the Geological Survey of India in the Indian Museum, Calcutta, contains 468 *falls* and *finds* from various countries and is one of the most important in the world. One thousand two hundred and fifty-eight known meteorites are now listed. More than one in every three, therefore, is represented in the Indian Museum. The specimens are exhibited in four handsome cases with explanatory labels in English, Bengali and Urdu. Every effort is made to obtain new specimens and these are carefully studied and the results published for the information of the scientific world.

The largest meteorites are all *Irons*, the largest known mass at Hoba in South-West Africa weighing 54 tons. The largest known *Stone* meteorite fell at Long Island, Kansas, and weighed 1,275 lbs. The immense masses of the large meteorites, the impact of which on the earth has been responsible for the formation of remarkable craters, can only be conjectured.

Many of the iron meteorites which have been found were not observed to fall. On the other hand, most stony meteorites have been seen to fall.

It is estimated that the oldest known iron meteorite solidified 2,900 million years ago. It has also been estimated that if meteorites are scattered portions of our solar system, their age should not be greater than 3,000 million years; but if they come from other stars, their period of solidification might date back some 10,000,000 million years. The determined date of solidification of iron meteorites thus accords with the assumption that they belong to our solar system.

* * *

Forecasting River Movements.—As a result of the investigations carried out on models at the *Central Hydrodynamic Research Station* at Poona, it is now possible to forecast tendencies to changes in river courses, though not the magnitude or the extent of the changes, but greater accuracy is expected with further improvements in the technique of reproducing in a model the changes which occur in the course of a large alluvial river which is now being developed.

Experiments are being conducted at the station on a 1/500 model of the Ganges above the

Hardinge Bridge. A number of difficulties have been encountered and means are being devised to overcome them. The greatest difficulty, for which only a partial solution has so far been devised, has been to reproduce silt deposition which plays a large part in the changes of river courses. The difficulty arises from the fact that small channels carry a relatively much smaller proportion of silt in suspension than large channels.

The results of the 1935 flood in the model were almost identical with those of the prototype, but success was not equally satisfactory with other experiments. The problem is being further studied.

* * *

Water Level Recorders.—Two automatic recorders, one for use in seepage drains and another for recording fluctuations of supply channels have recently been designed and made by a Punjab engineer.

The seepage drain recorder which is known as 'CAM' Recorder is entirely self-contained. The drum on which the chart is placed is driven by clockwork filled with jewelled escapement and will run for one month for each full winding and the recording pencil will last for the same period. The chart moves forward at one-tenth of an inch per hour and three days recording will be seen at a glance.

The other instrument which is called 'ZEM' Recorder can be set to operate either at the head or tail of a supply channel. The pencil operating on the chart of the instrument can be set to the correct indent and fluctuations in the supply are recorded either above or below the line in the centre. The range can either be six inches up and six inches down or three inches up and three inches down. The chart moves at the rate of one-tenth of an inch per hour and one roll will last twelve months. The drum on which the chart is placed is driven by a one-second electric pendulum clock actuated by a battery of five dry cells and will run for at least six months without attention. The recorder can be allowed to read up to 14 feet range by fitting in differently pitched screws.

The float arrangements for both gauges consist of an eight-inch copper float fitted in a twelve-inch light steel tube and cannot be tampered with. This tube requires a twelve-inch square well or can be placed in an open channel.

* * *

Drying of Fruits.—The *Imperial Council of Agricultural Research* have recently directed their attention to the founding of a dried fruit and vegetable industry, in the North West Frontier Province, where a large variety of fruits are grown. Encouraging results have already been obtained at the Tarnab Farm and dried specimens sent to England for examination, have been favourably commented upon.

Drying constitutes a very valuable method for preserving fruits and possesses certain distinct advantages over canning. Thus the process does not demand the employment of expensive equipment and it lends itself to easy manipulation. It is a recognised method of fruit preservation and in fruit-growing countries a large proportion of the production is treated in this manner. Thus in California about 65 per cent. of the crop is disposed off in the dried form.

India imports annually Rs. 9,00,000 worth of dried fruits from Afghanistan.

* * *

Indian Meteorological Department.—It is announced that Temperature Forecasts, prepared by the Meteorological Offices at Poona, Calcutta, Karachi and Delhi will be included in the daily weather reports, as a routine measure.

Temperature forecasts were being included in the reports during the period 1890–1905. This practice was given up in 1906, with a view to shorten the reports. After the occurrence of the unusually intense cold wave in the winter of 1928–29, the Meteorological Department felt that it would be useful to issue temperature forecasts whenever large changes were expected.

Forecasts of abnormal temperatures are of use to agriculturists, engineers, medical men and industrialists. Timely warnings of cold and heat waves are very valuable to agriculturists, who can take appropriate steps for minimising losses due to such abnormalities.

* * *

Manufacture of Liquid Gold.—That there should be no difficulty in manufacturing liquid gold in India, even during war time, and that the manufacture would be profitable, is suggested by the Industrial Research Bureau in their Bulletin No. 16, "Manufacture and Application of Liquid Gold", issued recently.

Used extensively by the Indian glass bangle industry and manufacturers of ceramic articles for decoration purposes, liquid gold has hitherto been exclusively imported from abroad. Since the outbreak of war, its supply has become greatly restricted.

The product contains gold to the extent of about 80 per cent. of its value, the remaining 20 per cent. covering the cost of manufacture and the various chemicals required. The cost of manufacture has been carefully estimated and the availability of raw materials considered from the point of view of pre-war as well as war-time conditions.

The annual consumption of liquid gold in the manufacture of glass bangles and in the ceramic industry in India has been estimated at approximately 20,000 ozs., worth about Rs. 4,00,000 at current market prices. The major portion of this, or about 18,000 ozs., is consumed at Ferozabad (Agra District, United Provinces), which is the principal centre of glass bangle manufacture in India.

Liquid Gold is a dark, oily, viscous substance containing resinates of gold and other metals dissolved in essential oils. The minor constituents present are resinates of bismuth, chromium and rhodium. The function of bismuth resinate which forms bismuth oxide on firing, is to fasten the gold film to the glass or porcelain surface to which it is applied. Chromium resinate appears to play a part very similar to bismuth resinate. The chief function of rhodium resinate is to render the film of metallic gold lustrous.

The article on which the decorative design is applied by means of a feather or fine brush, is air dried and fired in a suitable muffle furnace at a gradually rising temperature up to about 650–700° C. During the process, the organic matter burns off leaving a bright film of metallic gold.

The Bulletin describes at length the processes for preparing liquid gold. Semi-commercial trials have been successfully carried out and costs worked out.

ASTRONOMICAL NOTES

Planets during July 1940.—Mercury continues to be an evening star in the early part of the month; it is in inferior conjunction with the Sun on July 22 after which it passes into the morning sky. Venus, which is gradually moving away from the Sun, will be a conspicuously bright object visible in the eastern sky sometime before sunrise. Its brightness is increasing and towards the end of the month it is approaching greatest brilliance, when its stellar magnitude is $-4 \cdot 2$. It will appear stationary on July 18; and there will be a close conjunction of the planet with the Moon on July 31. Mars continues to be too near the Sun in the evening sky and cannot be well observed during the month.

Jupiter rises about an hour after midnight and will be a conspicuous object in the early morning sky. It is gradually getting brighter, the stellar magnitude being $-2 \cdot 0$ at the end of the month. Very close to it and about two or three degrees to the south-east, is the planet Saturn visible as a yellowish star of the first magnitude. The ring system is slowly getting wider, the angular dimensions of the major and minor axes of the ring ellipse being $39'' \cdot 4$ and $13'' \cdot 6$ respectively about the middle of the month. In the same part of the heavens will be seen Uranus which is moving slowly eastward in Taurus about five degrees south of Alcyone the brightest star of the Pleiades cluster. Neptune being in the constellation Leo, can be seen in the western sky in the early part of the night. It is situated about midway between the two-fourths magnitude stars ν Leonis and ν Virginis and can be located with a small telescope.

Omicron Ceti (Mira).—This interesting variable start is expected to reach maximum brightness about July 28, when it is likely to be of the second magnitude. The star is a regular long-period variable with a range of variation of nearly eight magnitudes and the period is $331 \cdot 8$ days. The position is given by R.A. 2^h 16^m and declination 3° 15′ S. The star is of a deep-red colour and when at maximum, can be easily picked up a little to the south-west of the stars α and γ Ceti. In July it will be nearly on the meridian just before sunrise.

T. P. B.

SEISMOLOGICAL NOTES

During the month of May 1940, seven slight, four moderate and one great shocks were recorded by the Colaba seismographs as against five slight and six moderate shocks recorded during the same month in 1939. Details for May 1940 are given in the following table:—

Date	Intensity of the shock	Time of Origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
		H.	M.	Miles		Miles	
May 4	Slight	12	54	5610			
5	Moderate	02	32	1630	North east Iran		
6	Slight	11	32	1470			
8	Slight	03	54	2390			
11	Slight	19	25	5570			
12	Moderate	02	30	1450	23° N., 95° E. (Upper Burma)		
19	Moderate	10	13	8400	Probably in California		Three killed in Elcentro in Southern California & 20 in Mexican Border
19	Slight	20	48	4060			
19	Slight	23	47	3920			
24	Great	22	04	10400	Near 8° S., 83° W. (off the Coast of Peru)		200 killed, 5000 injured and 2000 houses destroyed
27	Slight	9	40	1270	36°·5 N. 70°·5 E. (Hindukush)	125	Felt in Peshawar
28	Moderate	15	11	4630	3° S., 138° E. (New Guinea)		

MAGNETIC NOTES

Magnetic conditions during the month of May 1940 were almost similar to those in the preceding month. There were 9 *quiet* days, 20 days of *slight* disturbance and 2 days of *moderate* disturbance as against 5 quiet days, 23 days of slight disturbance and 3 of moderate disturbance during May 1939.

The quietest day during the month was the 4th and the most disturbed day the 24th. The classification of the magnetic character of individual days during the month was as follows:—

Quiet days	Disturbed days	
	Slight	Moderate
3–6, 8, 14, 16, 30, 31.	1, 2, 7, 9–13, 15, 17, 19–23, 25–29.	18, 24.

There was one moderate storm during May 1940, as against two storms of moderate intensity in May of last year. The mean character figure for the month is 0·77 while that for May 1939 was 0·94. M. R. RANGASWAMI.

ANNOUNCEMENTS

The sixth International Congress for Experimental Cytology which should have been held at Stockholm from July 25 to August 1, 1940, has been postponed on account of the international situation.

The organizing council announce that the International Congress of Mathematicians which was scheduled to be held at Cambridge, Mass, in September 1940, has been postponed.

The **British Association** intends, unless unforseen events intervene, to hold a conference in the University of Reading, by the kind permission of the Council of the University, during July 25–27. The general reference will be to science in national and international aspects, and Sir Richard Gregory, President of the Association, will open the conference as chairman. Thereafter there will be meetings in four groups, dealing respectively with international intellectual co-operation; natural resources and national needs; social aspects of human nutrition; and scientific discovery and progressive industry.

Royal Society of Arts.—As a means towards the economy in paper necessitated by the Government rationing scheme, the Council have decided that the *Journal* shall, as a temporary measure, be published fortnightly. Each fortnightly issue will be in the nature of a double number, and contain the report of two meetings instead of one. Fellows will thus receive the same subject-matter, but by a more economical method.

The attention of our readers is drawn to two advertisements appearing elsewhere in this number: (1) Inviting applications for the post of University Professor of Physical Chemistry, University of the Punjab; Salary Rs. 600–40–1,000; last date for receiving applications, 15th July 1940; and (2) Requesting exchange or sale of *Homoptera* by Dr. S. Mahdihassan, Osmania Medical College, Hyderabad.

* * *

We acknowledge with thanks the receipt of the following:—

"Journal of Agricultural Research", Vol. 60, No. 1.

"Agricultural Gazette of New South Wales", Vol. 51, Pt. 5.

"Journal of the Royal Society of Arts", Vol. 88, No. 4559.

"The Nagpur Agricultural College Magazine", Vol. 14, No. 4.

"Indian Journal of Agricultural Science", Vol. 10, No. 2.

"Allahabad Farmer", Vol. 14, No. 3.

"Biological Reviews", Vol. 17, No. 2.

"Journal of the Indian Chemical Society", Vol. 17, No. 4.

"Russian Journal of Chemistry", Vol. 9, Nos. 17–24.

"Chemical Products", Vol. 3, No. 5.

"Comptes Rendus Doklady", Vol. 26, Nos. 6 and 7.

"Experiment Station Record", Vol. 82, No. 3.

"Indian Forester", Vol. 66, No. 6.

"Indian Farming", Vol. 1, No. 5.

"Transactions of the Geological, Mining and Metallurgical Society of India", Vol. 10, Nos. 3–4.

"Records of the Mysore Geological Department", Bull. No. 17.

"Bulletin of the Indian Central Jute Committee", Vol. 3, No. 2.

"Review of Applied Mycology", Vol. 19, No. 4.

"The Bulletin of the American Meteorological Society", Vol. 21, No. 4.

"The Mathematics Student", Vol. 8, No. 1.

"Indian Medical Gazette", Vol. 75, No. 5.

"American Museum of Natural History", Vol. 45, No. 4.

"Nature", Vol. 145, Nos. 3677 and 3678.

"Journal of the Bombay Natural History Society", Vol. 41, No. 3.

"Indian Journal of Physics", Vol. 14, Pt. 1.

"Canadian Journal of Research", Vol. 18, No. 4.

"Journal of Research" (National Bureau of Standards), Vol. 23, Nos. 5–6.

"Indian Trade Journal", Vol. 137, Nos. 1769–72.

"The Lingnan Science Journal", Vol. 19, No. 2.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

May 1940. SECTION A.—C. V. RAMAN AND P. NILAKANTAN: *Reflection of x-rays with change of frequency—Part I. Theoretical discussion; Part II. The case of diamond; Part III. The case of sodium nitrate.* The optical analogy of the scattering of light in crystals indicates that when X-rays traverse a crystal they excite pulsations in the crystal lattice having the characteristic infra-red frequencies, and these pulsations in turn cause periodic variations in the structure-amplitude of the crystal spacings, and therefore result in reflections of the X-rays with change of frequency. In the case of diamond, the 1332^{-1} frequency is effective. Sodium nitrate exhibits intense modified reflections by several of the crystal spacings. K. V. BOKIL AND K. S. NARGUND: *Synthesis in the chaulmoogric acid series—Part II. Synthesis of Δ^3-cyclopentene carboxylic acid.* T. M. K. NEDUNGADI: *Raman effect in Rochelle salt crystals.* 25 Raman shifts are recorded along with 4 water bands. The intensities of many of the Raman lines change markedly for varying orientations of the crystal axes, even when the incident light is unpolarised. R. D. DESAI AND (MISS) K. S. RADHA: *The action of hexamethylenetetramine on the methyl esters of phenolcarboxylic acids.* G. V. L. N. MURTY AND T. R. SESHADRI: *Raman effect and chemical constitution. Influence of constitutive and other factors on the double bonds in organic compounds—Part IV. The frequency of the ethylenic double bond in unsaturated carboxyl compounds.* Raman spectra of cinnamyl acetate alcohol and cinnamyl acetate are compared with those of ethyl cinnamate. K. SAMBASIVA RAO: *On the representation of a number as the sum of the kth power of a prime and an lth power-free integer.* F. C. AULUCK: *On Warings' problem for biquadrates.* E. MCKENZIE TAYLOR: *Some aspects of the physics of water-table rise and salt movement in the soil under irrigated conditions.* The importance of the presence of a zone of field capacity moisture content on the movement of moisture in a soil has been investigated. There is no essential connection between the rise of water-table and the rise of salts in the soil.

May 1940. SECTION B.—KHAN A. RAHMAN AND AMAR NATH SAPRA: *Mites of the family tetranychidæ from Lyallpur with descriptions of four new species.* Seven species of phytophagous mites of which four are new, are described and biological notes for each species given. H. S. RAO: *On the anatomy of* Lycopodiopsis derbyi *Renault with remarks on the southern palæozoic lycopods;* A re-examination of one of the few interesting silicified plants known from Brazil. A. ANANTHANARAYANA AYER: *A note on the morphology of the iliofemoral ligament of the hip-joint.* The study has furnished additional evidence for the view that the muscle iliacus minor and the medial limb of the iliofemoral ligament are homologous structures. M. S. RANDHAWA: *A note on a club-shaped variety of* Botrydium granulatum *(L.) Grev. Var.* Clavaeformis *Var. Nov.*

Indian Association for the Cultivation of Science: (*Proceedings*)

February 1940.—SACHINDRA MOHAN MITRA: *Splitting of spectral lines at scattering by liquids.* S. S. BANERJEE: *Input impedance of high-frequency parallel wire transmission lines immersed in an absorbing medium.* D. V. GOGATE AND D. S. KOTHARI: *Degeneracy in Non-relativistic Bose-Einstein statistics.* B. B. RAY, S. R. DAS AND N. BAGCHI: *Secondary K-Absorption edges of cobalt salts in solid and liquid solutions.* RAM NIVAS RAI: *On sources of stellar energy—A criticism of the Bethe-Gamow theory.* N. BAGCHI: *On the width of the K-Absorption edge of cobalt.* A. C. BANERJI: *The spiral arms of a configuration of rotating compressible mass having uniform density and surrounding an incompressible spheroid of homogeneous mass.* A. K. DUTTA: *Second maximum of Rossi curve.*

Indian Chemical Society:

April 1940.—S. M. SETHNA AND R. C. SHAH: *Pechman condensation of p-orsellinic acid with ethyl-aceto-acetate. Synthesis of 7-hydroxy-4: 5-di-methylcoumarin.* BALKRISHNA H. IYER: *Extension of reformatsky reaction—Part I. Study with ethyl bromomalonate and acetone.* M. S. TELANG AND V. V. NADKARNI: *Kinetics of the reaction between potassium persulphate and the alkyl iodides—Part II.* K. C. SAHA: *Biological value of the proteins of Bengal fish.* P. L. NARASIMHA RAO: *Chemotherapy of bacterial infections—Part I. Substances related to sulphanilamide. Synthesis of p-aminobenzylsulphonamide and its derivatives.* RAFAT HUSAIN SIDDIQUI: *Strychnine and brucine—Part V. Some derivatives of dinitroisostrychnic acid.* S. M. SETHNA AND R. C. SHAH: *Kostanecki-Robinson Reaction—Part I. Acetylation of Orcacetophenone and its monomethyl ether.* S. J. DAS-GUPTA: *Acridine derivatives—Part V. Aurothio- and argentothio-Acridines.* K. MITRA, H. C. MITTRA AND A. C. ROY: *Nutrition studies in Bihar—Part III. Estimation of carotene and ascorbic acid in common fruits and vegetables.* B. N. GHOSH AND N. C. MUKHERJEE: *Measurement of swelling and electrokinetic potential of fibrin at various hydrogen ion concentrations.* K. C. SAHA: *Effect of boiling and frying on the enzymic hydrolysis of fish protein.* SATYENDRA NATH CHAKRAVARTI, MAHADEVAN SWAMINATHAN AND P. R. VENKATARAMAN: *O-Aldeyhdo-carboxylic acids—Part III. A synthesis of 4:5-methylenedioxyphthalaldehydic acid and new synthesis of 4- and 5-methoxyphthalaldehydic acids.* JAGARAJ BEHARI LAL: *Chemical examination of* Blepharis Edulis, *Pers.—Part III. Constitution of Blepharin.* D. N. MAJUMDAR AND (LATE) G. C. CHAKRAVARTY: *The Constituents of alkanet root* (Anchusa tinctoria, *Lam.*)*—Part II. Anchusin and its derivatives.* PHANINDRA BHUSHAN DUTT, NARENDRA CHANDRA DEB AND PRAFULLA KUMAR BOSE: *A preliminary note on Mesuol, the bitter principle of* Meusa ferrea. U. P. BASU AND A. MAJUMDAR: *A note on the keeping properties of* Hydnocarpus wightiana *oil and its derivatives.*

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CURRENT SCIENCE

Vol. IX] JULY 1940 [No. 7

BOYCOTT OF GERMAN SCIENTIFIC MATERIALS

TWO remarks encountered in the very early war days of 1914 still remain clearly in the present writer's memory and unfortunately have lost none of their significance with the passing years.

At that time there was a large German colony in Manchester whose relations with the rest of the population were quite friendly. The German Consul was "hail fellow well met" with a large circle of acquaintance. The first of the two remarks above mentioned was his eager assurance to the present writer, on one of the few days before England declared war, that "It will be only a short war, Germany just wants some share in the French colonies!"

The second observation was made by a Dutch technologist, discussing the German mentality with some members of the Manchester Chemical Club. He exclaimed: "Zey haf no zychology."

Both these characteristics of the present Nazi regime, their emphasis on the need for colonies and the absence of psychology, have a clear bearing on the consideration of the *Report to the Cambridge and Boston Branch of the American Association of Scientific Workers* which has recently come to hand from Boston.

In the first place the Report draws attention to the fact that the ideology of the Nazis has resulted in the utilisation of science for purposes of enhancing armaments and promulgating racial hatred. These purposes are evident from the appointment of military experts as directors of scientific researches

and the published diatribes concerning Aryan and non-Aryan science and scientists. As a result of the Hitler regime there has been a definite decrease in the quantity and quality of published scientific research in Germany. Many of the leaders in scientific fields have left or have been forced to leave the country.

In consequence of these facts, which have been established after careful investigation by the members of the *Cambridge and Boston Branch of the American Association of Scientific Workers*, the membership of the Association has voted to investigate the possibility of a boycott of German scientific materials as a means of expressing effectively its disapproval of the Nazi attitude towards science and scientists.

In this connection the present economic situation of Germany is first considered in the Report and it is thought that owing to the alleged statement by Hitler, "We must export or die", the loss of export trade in scientific materials might constitute a threat to which serious attention would be paid.

It is possible, however, that the American Committee is still under the influence of the "gold mentality" since all the gold in the world is gravitating to the vaults of the United States. When it is safely interred there, America, as H. G. Wells remarks, may be considered to have won the Gold Standard game. The Committee may thus be liable to exaggerate the importance of the present shortage of gold in Germany. It may be remembered that certain financial pundits foretold an early end to the last war through lack of money to carry it on. Later it was realized that provided a river continues to flow, the abstraction of water from it in one year does not affect the quantity available during the succeeding years.

Consequently in response to similar warnings Hitler is reported to have exclaimed: "The money is here. There will always be money. So long as the German people work, I am not afraid." That their work has resulted in guns rather than butter does not alter the principle involved.

The question of colonies, nevertheless, does raise currency difficulties. The trouble is not that supplies of raw material are unavailable, but that they have to be paid for in the currency of the country controlling the colony or dominion concerned. Hence the need for exports emphasised by Hitler, as a means for obtaining foreign currency.

The importance of an international currency unit as an element in removing one outstanding cause of war is thus evident.

While the importance and desirability of a boycott of German scientific materials may be unreservedly supported, it would seem better therefore to stress other aspects than the merely financial pressure, which in any event may not be as effective as orthodox economists are liable to imagine.

A non-emotional reason for boycott, which would be at the same time effective propaganda, would be the well-founded belief that scientific goods produced under the present conditions in Germany must needs be of inferior quality.

A continued cultivation of a spirit of untruth must have its effects in other spheres than personal or national ethics. If as is

reported, young Nazi students are reluctant to submit to the discipline of the mathematical sciences, it is unlikely that the engineers and artificers of the next generation can be depended upon to turn out trustworthy products whether motors or microscopes. Clearly, the present Nazi Germany is living on the intellectual capital of an older generation. This is confirmed by the reference in the Report to attempts which have been made to return a certain number of Jewish intelligentsia to Germany.

An effective boycott of scientific apparatus and materials should not be as difficult as it was in the war of 1914–18. The alleged superiority of German products is a suggestion fostered by propaganda. Dyes, chemicals, porcelain and glassware of first rate quality have been available in England since the last war. British microscopes, balances, and instruments of precision generally have always held their own.

In the United States the obsession as to the superiority of German goods has lasted longer, not having been exorcised under the stimulus of necessity. There is no doubt that American manufacturers can turn out excellent materials in all spheres as a result of remarkably widespread technical research of the order exemplified in the Mellon Institute Reports. In the latest of these, just to hand, reference is made, *e.g.*, to optical glass.

Here in India there is a great field awaiting development. Beginnings have already been made with chemical balances at Agra, and laboratory fine chemicals in the General and Organic Chemistry Departments at the Indian Institute of Science, and in other academic laboratories. Refractory porcelain is being successfully manufactured on a large scale at the Government Porcelain Works at Bangalore. The construction of electrical instruments of precision, particularly in the field of wireless, is being developed in the Department of Electrical Technology at the Indian Institute of Science. The necessary training for workmen who will be competent to construct instruments of precision is already available on a modest scale under Dr. Parameshwaran at Trivandrum, and under Principal Bence Jones of the Maclagan Engineering College, Lahore, from whom a bulletin on the subject was advertised some time ago by the Industrial Research Bureau.

Great expectations may justly be entertained of the results likely to accrue from the activity of the newly appointed *Board of Scientific and Industrial Research* under the brilliant leadership of Dr. Bhatnagar.

The scientific community of India may therefore confidently and unreservedly support their American colleagues in their resolution to boycott all German scientific material for which duplicates or suitable substitutes can be obtained elsewhere, to give the boycott the widest publicity, and to endeavour by every means to stimulate the production of such material in their own country.

Let it not be said that through lack of energy and enterprise the industrialists and scientists of India have left the doors of their country open to the burglarious entry of predatory powers.

GILBERT J. FOWLER.

A STATISTICAL STUDY OF THE WEIGHTS OF OLD INDIAN PUNCH-MARKED COINS

BY
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(*Fergusson College, Poona*)

THE punch-marks on old silver coins found in India have presented an unsolved riddle which has been attacked by a classification of the *obverse* marks. The efforts of Messrs. Durgā Prasād,[1] Walsh,[2] Allan,[3] in this direction will be valuable to future scholars, but as yet lead to no conclusion. The first two have paid some attention to the reverse marks also, while the third sometimes ignores them; the reason for this partiality to the obverse is that a group of five marks occurs systematically there, while the reverse may be blank or contain from one to sixteen marks.

The most important qualities of the coins in the ancient days were undoubtedly the weight and the composition. The latter has received very little attention, a coin or two being sampled from each new lot. The former is given as a rule, for every coin, but the statistical study of a coin group by weight does not seem to have been attempted.[5] The resulting confusion as to what standard of weight actually existed can be seen by consulting any of the above works; even Rapson[4] found documentary evidence too self-contradictory for use.

For the basis of a preliminary study, I took Walsh's memoir[2] on two Taxila hoards as fundamental. The work is full of oversights and mistakes, as I have shown in a note to be published in the *New Indian Antiquary*. Nevertheless, it is the only sizeable mass of data available to me, and I take all figures from Appendix XI, with the hope that no error of any importance enters into the weighing. Excluding the 33 Long Bar coins which approximate to Persian sigloi, and the 79 minute coins, all the rest, to a total of 1059 coins which seem meant to represent the same amount of metal, average 52·45 grains in weight. The 162 later coins (App. XII) of a single coinage average 52·72 grains. But the standardization of weights was not the same, as is shown by applying the z test to the variances of the two lots.

But even the main hoard of 1059 *kārṣāpaṇa* is not homogeneous. So, I classified them by the number of reverse marks and found the following data, in which the 64 double obverse coins have been omitted.

In Table I n is the number of coins with the number x of reverse marks given at the column head, and m the average weight in grains. One coin in the square 10-reverse mark class has been omitted, because it has a decidedly different history from that of the rest.[6] There exist coins with as many as 16 reverse marks, but counting the number of marks becomes difficult, and the total not tabulated being 15 square coins and 7 round, the table given below will represent substantially the most reliable portion of the data available to us.

It is seen at once that there is a regular drop in average weight with increase in the number of reverse marks. In fact, for the square coins, the linear regression can be fitted accurately enough by eye and is found on calculation to give the formula: $y = 53{\cdot}22 - 0{\cdot}212\,x$, where y is the average weight in grains and x the number of reverse marks. For round coins, the fit is not so good, though still satisfactory, the regression being $y = 53{\cdot}1 - 0{\cdot}214\,x$. That

TABLE I

	x =	0	1	2	3	4	5	6	7	8	9	10
Square	n =	224	128	132	85	64	46	21	25	10	9	8
	m =	53·26	52·93	52·74	52·47	52·53	52·17	52·03	51·67	51·40	51·47	51·01
Round	n =	58	34	29	28	25	10	13	8	9	3	3
	m =	53·35	52·84	52·75	51·90	52·29	51·67	51·82	52·23	51·23	50·10	51·20

is, practically the same line serves for both (Fig. 1).

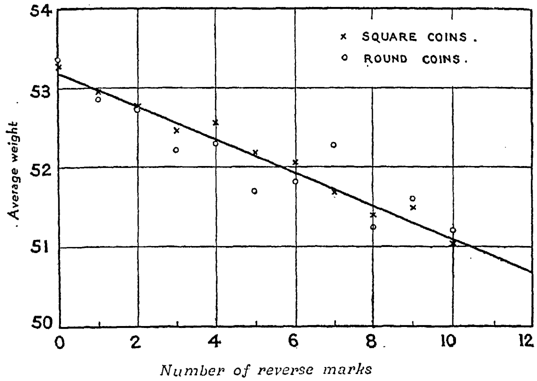

FIG. 1

The second result concerns the number of coins in each group. For simplicity, taking the sum y of both round and square with a given number x of reverse marks, the drop in number is exponential (Fig. 2). That is,

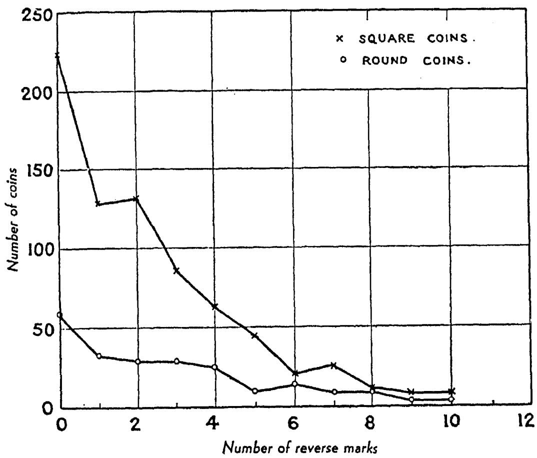

FIG. 2

the regression is given by $y = 283{\cdot}86\, e^{-x/3}$. This was obtained by taking the logarithm of the number of coins with each x, and fitting a linear regression. The divergence between the formula and the observed number is not significant by the χ^2 test, and the calculation obtained from the above table serves also for the omitted coins, giving, for $x = 0$ to 16, a value of χ^2 with P near $0{\cdot}2$; on the whole, a just tolerable fit.

These two results are quite startling. They show that the reverse marks—irregular as they might appear—were not distributed at random, for had they been so distributed, we should have obtained a Poisson distribution or something of the sort for the number of coins as a function of x; and the linear regression for weight would not have fitted so well. The only hypothesis that can account for our results is that *the reverse marks are checking marks stamped on by contemporary regulators or controllers of currency, at regular intervals.*

If accepted, this means that among the obverse marks, there might exist some symbols that specify the date of issue of the coins. This would, possibly, account for the fifth variable symbol found on the obverse. Even now, we have a sixty-year cycle with a name for each year, and there certainly existed an older 12-year cycle, still extant in Chinese and Tibetan tradition, which was converted into a sixty-year affair by associating twelve years with each of the five elements. This could account for one or two of the five obverse marks. One obverse mark is fixed: the sun symbol. If it is not votive, it might be a symbol of the metal itself. The next commonest mark is some form of the wheel, with (usually) six points of varying design. This *ṣaḍaracakra* is, in my opinion, not to be interpreted as a symbol of any deity, but as representative of the issuing authority, the *cakravartin* or king. The form of the points of the wheel, with perhaps one of the extra symbols, might be the ruler's personal monogram. This is borne out by the fact that in the few cases where the six-pointed wheel does not occur, we invariably get (with two exceptions) small homo-signs in their place (Durgā Prasād,[1] p. 41). That is, when the issue was not authorised by a king, it was authorised by a council of some sort.

Leaving these doubtful conjectures, we can use groupings by obverse marks for the purpose of weight analysis and compatibility tests, in particular the t test and the z test. I shall publish my results on this elsewhere.

Even in modern times, a certain amount of currency will be lost each year due to damage, hoarding, melting down, etc. This should, in stable times, be proportional to the actual number of coins in circulation. But when the coin does not represent full value in metal content, being just a token coin, with a rigorous control of weight by the examiners of currency, the formula for the number of coins surviving t years after issue would be given by

$$y = a\,e^{-bt}\left(\frac{1}{\sigma\sqrt{2\pi}}\int_{m_1-r}^{m_1+r} e^{-\frac{(x-m)^2}{2\sigma^2}}\,dx\right)$$

where: $m = m_1 - tm_2$

$\sigma^2 = \sigma_1^2 + t\sigma_2^2$

Here, a is a constant of integration, essentially the number minted. The legal weight, as also the average of freshly minted coins is taken as m_1, the variance at the mint as σ_1^2. The average loss of weight per year is m_2, and the variance of this annual loss, σ_2^2. The legal remedy, *i.e.*, the weight by which a coin may exceed or fall below the legal standard is called r in the formula.

When the coin is a source of metal, the first factor would account for most of the currency in circulation, particularly as the variances with modern technique of minting are very small. But with a token coin, and in any case after the passage of a greater number of years, the second factor would begin to dominate, and the coins withdrawn rapidly from circulation by those who check the currency. The phenomenon is similar to that often seen in biology, where a gene or culture of bacteria shows exponential *growth* till a threshold value is reached, when the situation changes entirely, the growth makes its own surroundings lethal, and further growth is either inhibited, or the whole of the variate vanishes altogether.

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1 *Journal and Proceedings of the Asiatic Society of Bengal*, New Series, 1934, **30**, Numismatic Number.

2 *Memoirs of the Archæological Survey of India*, 1939, No. 59.

3 *Catalogue of Indian Coins in the British Museum*, Ancient India, 1930.

4 *Ibid.*, Andhras, W. Kṣatrapas, 1908, p. clxxvii *et seq.*

5 The work of A. S. Hemmy, *Journal of the Royal Asiatic Society*, 1937, pp. 1–26 must be dismissed as mere trifling with an important subject.

6 One coin in the 3-mark round lot should also have been so omitted, bringing the mean to 52·20, which would have fitted much better.

SULPHANILAMIDE AND DERIVATIVES IN BACTERIAL INFECTIONS

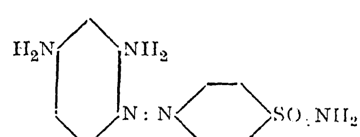
BY

K. GANAPATHI

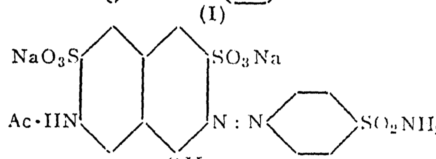
(Haffkine Institute, Parel, Bombay)

1. Prontosil and Related Dyes

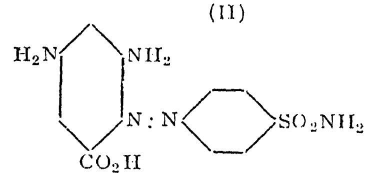
DOMAGK'S sensational discovery[1] of the specific curative effect of 'prontosil' (I) in experimental β-hæmolytic streptococcal infections in mice, which is hailed as the "greatest discovery in modern therapeutics", appears to have been made in 1932 as a culmination of his researches dating from 1923–24 in the Elberfeld laboratories of the I. G. Farbenindustrie.[2] Regarding the hosts of compounds that must have been tested systematically in the course of this investigation, we are given no details. The discovery was announced on the 15th February 1935[1] only after it was confirmed by three years of clinical trials at the hands of the Rhineland practitioners, for "by untimely publication he did not want to give false hopes to doctors and patients".[2] This dye (prontosil) being of low solubility in water (about 0·25 per cent.), a more soluble form, "prontosil soluble" ("prontosil S", "neo-prontosil", II) was introduced (as 2·5 per cent aqueous solution) for parenteral use, while in France, a carboxyl derivative of prontosil, "rubiazol" ("rubiazol C", III), synthesised by Gley and Girard[3] came into use.



(I)



(II)



(III)

2. Reduction of Prontosil *in vivo*: Evolution of Sulphanilamide

The next great advance in the subject was made by Tréfouël (J. and Mme.), Nitti and Bovet[4] in November 1935. They studied systematically the antistreptococcal properties of forty-five dyes of the azobenzene group[5] with various substituents and found that the replacement of the sulphonamide ($-SO_2NH_2$) group in prontosil (I) by $-AsO_3H_2$, $-SO_3H$, $-CN$, $-CONH_2$, $-CH_2.CO.CN$ and $-O.Ph$ groups destroyed the activity, while the amino group could be replaced by other groupings without much loss of activity. This led them to formulate the important hypothesis[4] that the therapeutic activity of prontosil is due to *para* amino-benzene-sulphonamide (sulphanilamide) liberated *in vivo* by reduction. In support of this they showed, for the first time, that the simple colourless compound, sulphanilamide (already synthesised by Gelmo in 1908 who never dreamt of its therapeutic properties), itself was as active as prontosil in experimental streptococcal infections. The above results were confirmed from various points of view by many workers. As an apparent proof of the hypothesis, Fuller[6] actually isolated sulphanilamide from the urine of a patient treated with prontosil. Ganapathi and Rao[7] have shown that following the feeding of six typical dyes of this group to groups of mice in therapeutic doses (10 mg.), only the therapeutically active once produce considerable blood concentrations (1·6 to 2·0 mg. per cent.) of sulphanilamide, whereas the very little active or inactive ones produce only traces.

Though till now about seventy dyes of the above group constituting various types have been reported, only a dozen of these have been found to be comparable in antistreptococcal activity to prontosil or sulphanilamide; it is yet to be shown definitely that these active dyes possess any advantage over the parent amines. As regards both the intensity as well as the poly-valency of therapeutic effect, the dyes are inferior to the free amines. For example, sulphanilamide shows a striking therapeutic effect in (β-hæmolytic) streptococcal, meningococcal, gonococcal, bacillus welchi and *B. coli* infections; its effect in B. typhosus infection is considerable; in pneumococcal infections, the protection is less and in staphylococcal infections far less. The dyes show considerable therapeutic effect in streptococcal infections and in the rest their efficacy compared to sulphanilamide is negligible. However, both the dyes and sulphanilamide possess considerable protective effect in the virus infection, lymphogranuloma inguinale.[8]

3. Seat of Therapeutic Activity in Sulphanilamide

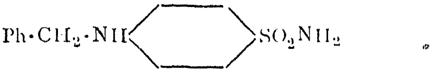
The next obvious step of elucidating the seat of chemotherapeutic activity in sulphanilamide was immediately taken up by Fourneau, Trefouels, Nitti and Bovet.[9] They studied 130 derivatives of related structures[5] and showed that for the antistreptococcal activity, (*i*) the amino and sulphonamido groups in the *para* positions of the benzene ring are necessary, (*ii*) the presence of an additional grouping in the benzene ring destroys the activity and (*iii*) the substitutions in the amino and sulphonamido radicals have variable activity depending on the nature of the substituents. These important findings led to such intense activity in the synthesis of new compounds of this group that, till now, about ninety papers have been published and forty patents taken, reporting in all about 600–700 compounds (besides a lot unpublished).

4. Compounds with Substituents in the Amino Radical of Sulphanilamide

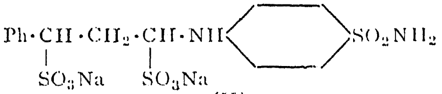
About 130 derivatives with various types of substituents in the amino radical of sulphanilamide have been reported, of which only about twenty possess anti-streptococcal activity comparable to that of sulphanilamide. Of these twenty derivatives, fourteen are Schiff's bases obtained by condensing sulphanilamide with variously substituted benzaldehydes.[10,11] Of the forty-five acyl derivatives reported,[5,12,13,14] the valeryl, caproyl,[12,13] and pyrrolidone carboxy derivatives[10] are as active as sulphanilamide. It is conceivable that all the above compounds can yield free sulphanilamide *in vivo* by hydrolysis. The guanidine[15] and formaldehyde sulphoxylate derivatives[16] of sulphanilamide are stated to be quite active.

4-Benzylaminobenzene sulphanamide (IV) first reported by Goissedet *et al*,[11] and introduced for clinical trials (under the trade names "proseptasine", "septazine"), has been shown to be inferior to sulphanilamide in experimented infections in mice.[10,16,17,18] It has been suggested by Lockwood and Robinson,[18] though it cannot be considered to be

definitely proved, that the activity of proseptazine is due to the sulphanilamide liberated *in vivo*. Another colourless compound, disodium *p*-(γ-phenylpropyl) aminobenzenesulphonamide-$\alpha:\gamma$-disulphonate (V), has been introduced for clinical trials under the trade name "soluseptazine" for parenteral use. The only animal experiments reported about it by Whitby,[17] do not indicate it to be superior to sulphanilamide. Though these



(IV)



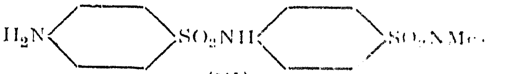
(V)

two drugs possess considerable antistreptococcal action, their therapeutic effects in other bacterial infections compared to sulphanilamide is negligible.[16,17] Schutz[19] has reported "soluseptazine" to protect rats and not mice in experimental P. pestis infections.

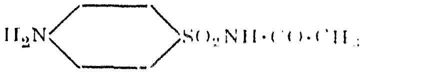
The *para* nitro, nitroso, hydroxylamino and hydrazo derivatives of benzenesulphonamide have been studied by Mayer.[20] The first two compounds are more active than sulphanilamide and more toxic, while the hydrazo derivative is inactive. The hydroxylamine derivative is about 100 times more bactericidal than sulphanilamide *in vitro*, but not *in vivo* (this being due to its reduction in the body to sulphanilamide). Some significance is attached to this compound in explaining the mechanism of action and also some of the toxic manifestations of sulphanilamide.[20,21]

5. Compounds with Substituents in the Sulphonamide Radical of Sulphanilamide

Forty derivatives with alkyl and aralkyl groupings substituted in the sulphonamide radical of sulphanilamide have been synthesised and tested but these have proved to be of no advantage. Of interest is the report of Adams *et al.*[13] that five derivatives with hydroxypropyl substituents in the sulphonamide radical show striking antimeningococcal but no antistreptococcal activity. Eighty-five derivatives of 4-aminobenzenesulphonanilide with various substituents in the second benzene ring have been synthesised and tested. Those with the nitro, amino, sulphonamido, substituted sulphonamido, N^1-sulphanilamido, sulphonic and carboxylic acid groupings in the second benzene ring are quite active and many reported to be even superior to sulphanilamide in antistreptococcal activity. Domagk reported[22] *p*-aminobenzenesulphonamidobenzene-*p*′-dimethylsulphonamide (known by the trade names, "Deseptal A", "Uleron" "Uliron", VI) to be superior to sulphanilamide in streptococcal and staphylococcal infections but this has not been confirmed.[16,23] It was given a fairly extended clinical trial in gonococcal infections but has now been withdrawn due to the toxic reaction of peripheral neuritis. A series of N^1-acyl derivatives of sulphanilamide has been reported.[24] The acetyl derivative ("albucid", VII), though far less active than sulphanilamide in streptococcal infections has been introduced for clinical trials in gonococcal infections with the claim that it is of low toxicity and very little of it gets acetylated *in vivo*. Crossley *et al.*[25] have reported five compounds of the disulphanilamide group (VIII) to be superior to sulphanilamide in antistreptococcal action.



(VI)



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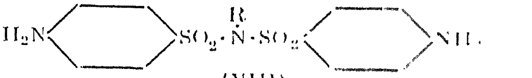


(VIII)

One of these, the sodium salt of disulphanilamide (VIII, R = Na), is claimed to protect mice infected with moderate doses of the influenza virus.[26] Adams, Long and Johanson[13] have reported thirty compounds with acyl substituents in the amino, and hydroxyalkyl substituents in the sulphonamido radicals of sulphanilamide. Of these, only eight are of interest for they are quite active in meningococcal but almost inactive in streptococcal infections.

6. Diphenylsulphone and Related Derivatives

Almost simultaneously, Buttle *et al.* in May 1937,[27] and Fourneau, *et al.*[28] In June-July of the same year reported the remarkably high antistreptococcal action of 4:4′-diaminodiphenylsulphone. This diamine

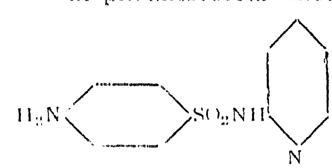
according to Buttle *et al.*[27] is about 100 times as active as sulphanilamide and 10 times more toxic in mice. In rabbits and monkeys, and possibly in man also, the toxicity as also the activity, do not appear to be so high. The diacetyl derivative (marked under the name "Rhodilone" in France for use particularly in gonorrhea) is relatively very little toxic and yet ten times as active as sulphanilamide. The 4:4′-dinitrodiphenyl sulphon is as active as sulphanilamide. The last two sulphone derivatives appear to be converted *in vivo* into the free amines.[29] The significance about these compounds is: (*i*) they do not contain the sulphonamide grouping and (*ii*) they are the best of the till then known compounds giving a definite percentage of survivors in experimental pneumococcal (type I) infections. In other types of pneumococcal infections, the action of the diacetylamino derivative is not so good.[30] In experimental typhoid infections, it is inferior to sulphanilamide. About fifty related derivatives of this diphenylsulphone group have been tested but only the benzylidene, glucose[31] and the formaldehyde-sulphoxylate derivatives[32] of 4:4′-diaminodiphenylsulphone have been suggested to be of some advantage. However these are not in use in practical therapy to-day.

About seventy related derivatives of the diphenylsulphoxide, diphenylsulphide, diphenyldisulphide and related compounds have been studied but they are generally of far less activity. 4-Nitro-4′-amino diphenylsulphoxide has been claimed by Levaditi *et al.*[33] to possess such specific effects in gonococcal infections as the arsenicals in the spirochætal infections.

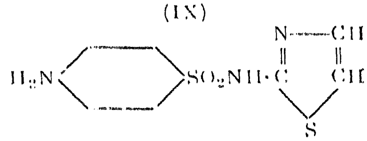
7. Heterocyclic Derivatives of Sulphanilamide

The discovery by Whitby,[34] announced in May 1938, of the remarkable protective effect of 2-N[1]-sulphanilamidopyridine ("Sulphapyridine", "Dagenan", "M. & B 693," IX), one of the forty-six compounds synthesised by Ewins and Phillips of the firm, 'May and Baker', in experimental pneumococcal infections in mice, is indeed a distinct advance in the chemotherapy of bacterial infections. The "dramatic cures" obtained with it in clinical trials in cases of pneumonia, have convinced us about its remarkable therapeutic properties. This compound is more polyvalent in action than sulphanilamide. The only experimental infection in which it is shown to be inferior to sulphanilamide is that due to B. typhosus; in streptococcal, meningococcal and gonococcal infections it is at least as good as sulphanilamide, while it is distinctly superior to sulphanilamide in pneumococcal, staphylococcal and P. pestis[19,43] infections.

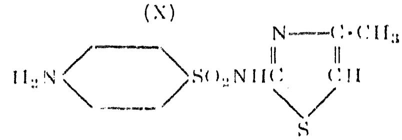
Of the hundreds of aromatic sulphur compounds synthesised and tested, though about seventy are about as active as and twenty-five distinctly superior to sulphanilamide in experimental streptococcal infections in mice, only sulphanilamidopyridine (IX) reigned supreme in its effect in pneumococcal infections. The presence of the heterocyclic ring in this compound gave thus the impetus to search for active compounds among the related heterocyclic derivatives of sulphanilamide. Thus, pyridine, quinoline, acridine, morpholine, piperidine derivatives are being tried. Though the trial cannot be said as yet to be complete, the quinoline, morpholine and piperidine derivatives do not show any promise. The search has been amply rewarded when attention was directed towards the thiazol derivatives by four groups of workers independently—by Fosbinder and Walter,[36] Iuda, Itikawa and So,[37] Lott and Bergeim[38] and Ganapathi and Nandi.[39] 2-N[1]-sulphanilamidothiazol (X) and the methyl derivative (XI) have been found to be as active as sulphanilamidopyridine (IX)[10,11,42,45] in pneumococcal infections.



(IX)



(X)



(XI)

Extensive researches with this thiazol derivative (X) (for which the short name "sulfathiazol" has been suggested[40]) at this Institute for the past several months, have convinced us that this new drug has a great future. While being far less toxic, it is even more polyvalent in action than sulphanilamidopyridine. In experimental strepto-

coccal infections in mice it is distinctly superior to sulphanilamide.[42] Sokhey and Dikshit[43] have found that it is far superior to sulphanilamidopyridine and almost a specific in experimental plague infections in mice. In staphylococcal infections also, these thiazol derivatives (X and XI) are distinctly superior to sulphanilamidopyridine. While the animal experiments are very encouraging, only extended trials have to pass the final verdict. In the meantime, similar heterocyclic derivatives are being prepared by the author and tested with the hope of obtaining even better compounds.

8. The Future of Bacterial Chemotherapy

Whatever be the future of "prontosil", which has brought about a renaissance in the Chemotherapy of Bacterial Infections, Domagk has indeed earned a place next to Ehrlich. The evolution of this subject, still in the cradle, from "prontosil" to "sulfathiazol" indicates that we are in the right way towards the conquest of the bacterial infections. The results obtained so far give us even the optimism that some day the dream of Ehrlich of *"a therapia magna sterilisans"*, will materialise at least in the treatment of some bacterial infections. There are many favourable indications for this, *e.g.*, in experimental meningococcal and B. typhosus infections in mice, sulphanilamide can give sufficiently high protection with even one dose of the drug. The achievements so far made are by themselves no means meagre. While Ehrlich met with "one moment" of success after seven years of disappointments, in the present case, in five years have been made conquests of a variety of deadly infections due to at least five types of bacteria. With far more extended trials, we can hope to conquer even the dreaded tuberculosis and detested leprosy.

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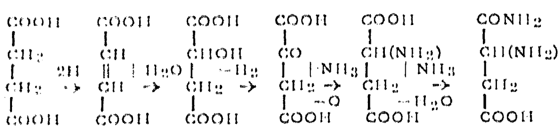
LETTERS TO THE EDITOR

Succinic Dehydrogenase in Germinating Seeds

ALTHOUGH asparagine occupies a central position in the amino-acid metabolism of plants little is known about the mechanism of its formation. On chemical grounds and from analogies based upon amino-acid synthesis in animal tissues it has been considered probable that the asparagine arises from succinic acid (frequently shown to be present in plants) and ammonia (arising from the deamination of amino-acids) by the following reactions (Kostytschew,[1] Chibnall[2]).



A serious difficulty in accepting this scheme has been the fact that succinic dehydrogenase, the enzyme necessary for catalysing the first step in the above chain of reactions, has hitherto not been found to be of general or wide distribution in the vegetable kingdom. In fact Thunberg to whom we owe the demonstration of the existence of many plant dehydrogenases, found the occurrence of this enzyme to be limited to the seeds of *Phaseolus vulgaris.*

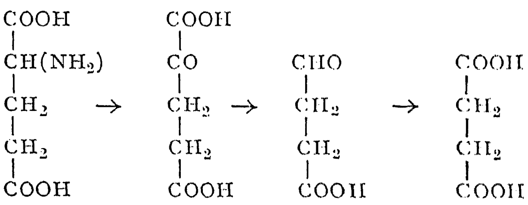
As the most marked accumulation of asparagine takes place in germinating seeds, we have examined the seedlings of a number of species for succinic dehydrogenase using the Thunberg Methylene Blue technique. It was found that seedlings of six species of Leguminosæ tested (*Phaseolus mungo, Phaseolus radiatus, Dolichos biflorus, Dolichos lablab, Cicer arietinum, Vigna catjang*) all show dehydrogenase activity towards succinic acid. The enzyme was on the other hand found to be absent from the seedlings of water-melon (*Citrullus vulgaris*) and rice (*Oryza sativa*). The seedlings were ground in a granite mortar with M/15 phosphate buffer (pH 9·0), pressed through muslin and centrifuged. The supernatant liquid (which was found to contain all the activity) was used for experiment, the reaction mixture being made up of 0·5 ml. of enzyme solution, 0·5 ml.

of N/10 sodium succinate, 0·3 ml. of M/400 methylene blue and 2 ml. of phosphate buffer (pH 7·8). In each case the tests were carried out till the seedling was 4 days old. The results in Table I of an experiment with *Phaseolus mungo* are typical of those obtained in several experiments with the Leguminosæ. Pronounced dehydrogenase activity was always found during the second and third days of germination, the activity afterwards decreasing rapidly.

TABLE I

Age of seedling (days)	Time of decolorisation of Me. Blue (Minutes)	
	Experiment	Control
1	26·0	29
2	3·5	9
3	8·0	16
4	36·0	42

The present findings taken in conjunction with the previously demonstrated presence of glutamic acid dehydrogenase (Damodaran and Nair,[3,4]) make it probable that in the Leguminosæ the accumulation of asparagine during germination might take place at the expense of glutamic acid, succinic acid being formed from the latter by the following reactions:



This is in keeping with the well-established fact that asparagine accumulation is accompanied by a decrease in the other amino-acids, the chief of which (in a quantitative sense) in most seed proteins is glutamic acid.

The explanation for the absence of succinic dehydrogenase in water-melon and rice seedlings might probably be that these plants belong to the type which elaborate glutamine in place of asparagine.

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R. RAMASWAMY.

University Biochemical Laboratory,
Madras,
June 19, 1940.

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Vitamin C Content of Germinated Cereals

THE Vitamin C content of pulses, particularly on germination, has been reported by a number of workers. So far as we are aware, no studies are reported on the Vitamin C value of cereals after germination. The common cereals such as Wheat, Maize, Bajra, Jowar and Rice, which are much cheaper than pulses, have now been examined for their ascorbic acid value, employing a large number of samples under different conditions. Table I gives the average values obtained by the chemical method.[1]

The results show that germinated cereals form a good source of ascorbic acid. The increase in ascorbic acid is of the same order as observed in the case of leguminous seeds.[2] The rate of germination is found to be different in different cereals. Usually the Vitamin C content keeps on increasing until the leaves open out well, after which there is a slight fall in Vitamin C content. In most cases, under the conditions of our experiments the maximum yield was observed between 72 96 hours except in rice and maize which germinated very slowly. The maximum yield was obtained in the case of Bajra, 23·8 mg. per 100 g. after 96 hours of germination. This cereal is the cheapest of all those examined by us. After germination, these cereals can be used either as ordinary vegetables, or they can be ground and the watery

TABLE I

Mg. per 100 grams

Name of cereal	Dry seeds	After germination for :					Remarks
		24 hrs.	48 hrs.	72 hrs.	96 hrs.	120 hrs.	
1. Wheat *(Triticum vulgare)* ..	2·6	3·1	8·8	9·7	15·0	9·15	Slow growth
2. Maize *(Zea mays)*	2·1	3·1	8·7	12·0	10·5	..	,,
3. Rice *(Oryza sativa)* ..	2·4	2·6	3·2	3·9	5·12	8·5	,,
4. Bajra *(Pennisetum typhoide* Rich.*)* ..	2·6	4·2	14·3	17·6	23·8	..	Good growth
5. Jowar *(Sorghum vulgare* Pers.) ..	1·96	3·4	10·6	11·5	15·8	..	Fair growth

extract taken as a drink with a small amount of salt or sugar.

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All-India Institute of Hygiene &
Public Health, Calcutta,
June 8, 1940.

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The Available Substrates in a Developing Fruit and Their Behaviour in Storage

A STUDY of the nature and the concentration of the substrates during the life-cycle of the fruit and their behaviour under different conditions of storage are of fundamental importance for a better handling of the storage problem. Such a study is particularly important in the case of Indian fruits which are exposed to the uncertain climatic conditions of the tropics.

From these standpoints, the behaviour of the available substrates in *Mangifera indica* with reference to storage and the effect of ethylene gas on them as a means of artificial ripening, were reported previously.[1] The results obtained in the case of another fruit *Pisidium guavœ* are briefly reported here.

The changes in the substrate concentration in the fruit growing in the tree are briefly summarised in Table I.

TABLE I
Fruits on the Tree

Substrates	Pickings from the same tree			
	Early Stage	Enlarging Stage	Maturity Stage	Senescence Stage
1. Protein ..	0·63	0·43	0·35	0·34
2. Starch ..	0·08	0·20	0·04	0·02
3. Total sugar ..	0·43	3·00	3·50	3·25
4. Reducing sugar	0·36	2·10	2·40	1·50
5. Titrable acid as citric acid	0·09	0·32	0·26	0·26
6. Alcohol insoluble residue	26·60	20·00	15·00	11·60

NOTE: Substrates calculated on the basis of % of fresh weight.

Table II shows the variations in the substrate concentration in the fruit under different conditions of storage.

The results show that the effect of ethylene is more marked on the fruits gathered at the maturing stage, in conformity with the

TABLE II

Fruits under storage

(Original Substrate Concentration: 100)

Substrates	Concentration at the end of a period of 7 days			
	Early Stage	Enlarging Stage	Maturity Stage	Senescence Stage
1. Protein ..	R—39·25 C—42·85 E—21·43	73·00 83·74 62·53	72·92 84·51 51·26	52·47 60·23 48·76
2. Starch ..	R—14·80 C—19·02 E—10·75	43·81 51·39 40·45	32·67 41·49 16·30	23·42 28·73 8·24
3. Total sugar	R—53·37 C—62·36 E—31·41	66·67 88·00 73·30	172·47 180·74 439·17	163·46 165·52 336·00
4. Reducing sugar	R—39·30 C—52·78 E—38·85	76·17 92·09 76·17	149·32 151·48 330·20	130·13 129·75 234·30
5. Titrable acid as citric acid	R—78·12 C—86·60 E—49·74	82·30 91·40 80·00	82·00 86·00 65·12	81·12 82·45 66·41
6. Alcohol insoluble residue	R—24·00 C—28·00 E—23·30	18·88 18·40 16·88	12·20 20·48 13·60	11·00 12·00 9·40

R—Stored in a room, temperature : 28° C.–32° C.
C—Cold storage do. 8° C.–12° C.
E—In an atmosphere containing 0·1% ethylene, temperature 28° C.–32° C.

previous report. Further investigations are in progress and the results will be published elsewhere.

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May, 16, 1940.

[1] Kar, B. K., and Banerji, H. K., *Nature*, 1939, **144**, 597.

A Note on the Embryo-sac of *Acalypha indica* L.

THE Euphorbiaceæ are well known for the abnormalities of embryo-sac development, presented by several genera. As many as four distinct types have been reported in this family:—(*a*) *Normal-type*, (*b*) *Allium-type*, (*c*) *Peperomia-type*, and (*d*) *Fritillaria-type*. Even the single genus *Euphorbia* shows all these variations (for detailed information see Maheshwari,[1] 1937).

The material of *Acalypha indica*, which was collected at Agra, showed almost all the important stages in the development of the ovule and embryo-sac. There are two integuments of which the inner remains small and the outer grows out to form the micropyle. Both remain free from each other and the inner from the nucellus, throughout the development of the embryo-sac. The obturator begins growth soon after the integuments have been laid down and finally fits over the beaked nucellus like a bell.

Usually there is a single archesporial cell (sometimes 2 or 3 may be found) which divides into the primary wall cell and the megaspore mother cell. The former divides both periclinally and anticlinally to give rise to the nucellar beak, in whose formation the epidermal cells also take some part. The latter (MEG. M. C.) enlarges and undergoes the two reduction divisions but no walls are laid down in this process, and each of the tetrad nuclei divides again so that four groups are formed consisting of two nuclei each. One more division takes place, resulting in 16 nuclei, arranged in four quarters. So far these observations correspond closely to those of Tateishi[2] (1927) on *Acalypha australis*. The organisation of the mature embryo-sac presents a great variation, however. In most cases the cytoplasm aggregates around 2 nuclei of each quartet and they become separated towards the periphery by the formation of a limiting membrane. Two nuclei of each quartet, which have remained free, migrate to the centre so that the secondary nucleus formed by their fusion is octoploid.

In a few cases the organisation of the E.S. was like that of the Penæaceæ with 4 groups of 3 cells each and only 4 free nuclei left in the centre (*cf.* Stephens,[3] 1909). Occasionally there was lack of any definiteness in organisation and some peculiar arrangements were seen, which

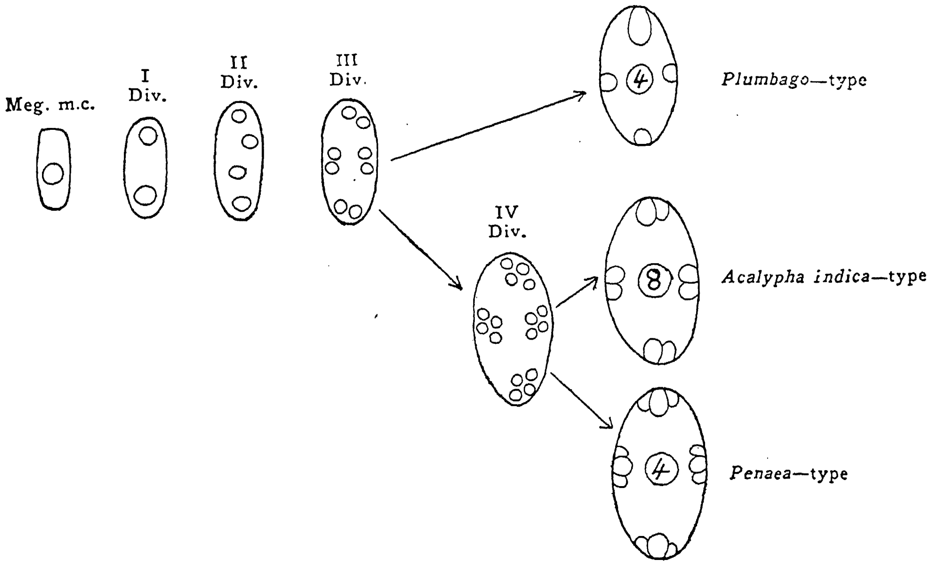

Diagram showing relation between embryo-sacs of *Plumbago*, *Acalypha indica* and *Penæa*

will be described in detail in the full paper. From what has been said above it will be apparent that the embryo-sac of this plant does not agree fully with any that has been described so far. It seems to be most closely related to the *Penæa*-type on the one hand and the *Plumbago*-type on the other (Haupt,[4] Dahlgren[5]). The diagram given above will serve to bring out the relationships more clearly.

Another paper, which is under preparation by one of us (P.M.) will show that all of these types are to be derived finally from the monosporic 8-nucleate embryo-sac which is met with in the majority of Angiosperms (see also Maheshwari,[6] 1939).

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B. M. Johri.

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Dacca,
May 18, 1940.

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A Note on "Double Fertilisation" in *Ephedra foliata*

Though the cases, in which "double fertilisation" (*i.e.*, fertilisation of the ventral canal nucleus as well as the egg by the two male nuclei discharged from the pollen tube) has actually been observed in the Gymnosperms, are few, yet considering the fact that the ventral canal nucleus is sister to the egg and therefore homologous with it, the theoretical possibility of its behaving like the former and being fertilised cannot be denied. As early as 1899, Chamberlain[1] called attention to a case in *Pinus laricio* where the ventral canal nucleus becomes as large as that of the egg, passing through a similar developmental history. In *Thuja* (Land,[2] 1902), the same ovule occasionally showed some embryos directed upwards into the nucellus and others going downwards into the gametophyte, and it was concluded that most probably the former were formed as a result of the activity of the ventral canal nucleus which had also been fertilised side by side with the egg. In *Ephedra trifurca* Land[3] (1907) saw a prominent nutritive tissue in the micropylar region of the egg cell, and Berridge and Sanday[4] (1907) made a similar observation

in *E. distachya*. Porsch[5] (1907), after a study of Land's figures and statements on the formation of the so-called nutritive tissue in *E. trifurca*, suggested the probability of its having originated from the ventral canal nucleus which was fertilised by the second male nucleus. In *Abies balsamea* (Hutchinson,[6] 1915) and *Ephedra campylopoda* (Herzfeld,[7] 1922) a fertilisation of the ventral canal nucleus as well as the egg was actually observed in several undoubted cases, thus confirming the interpretation of Land's figures by Porsch.

Maheshwari[8] (1935) figured an egg cell of *Ephedra foliata* in which the ventral canal nucleus had already begun to degenerate while the female nucleus was still unfertilised. A study of post-fertilisation stages in *E. foliata*, made by me, also confirms that usually the ventral canal nucleus has no further part to play. Nevertheless, two or three preparations were encountered which show a possibility of an occasional fertilisation of the ventral canal nucleus by the second male gamete. This is suggested by Fig. 1, which shows one male nucleus in proximity to the egg and another close beside the ventral canal nucleus (see also Fig. 2 *a* and b). In another fertilised egg cell (Fig. 3) four nuclei were seen of which the two basal ones are undoubtedly the primary proembryonal nuclei resulting from the egg nucleus. The other two, situated in the micropylar part, are much smaller and without the surrounding cytoplasmic sheaths characteristic of the former. Three interpretations are possible with regard to them, *viz.*:—

(*a*) That they are also proembryonal nuclei which have for some reason failed to keep pace with the other two and are on the way to degeneration.

(b) That they are nuclei of the jacket cells, which have "wandered" into the egg cytoplasm.

(c) That they are the two nuclei resulting from the division of the ventral canal nucleus after it is fertilised by the second male nucleus.

Of these the first interpretation seems to be the least likely, because no other case of a similar nature was observed although I had at

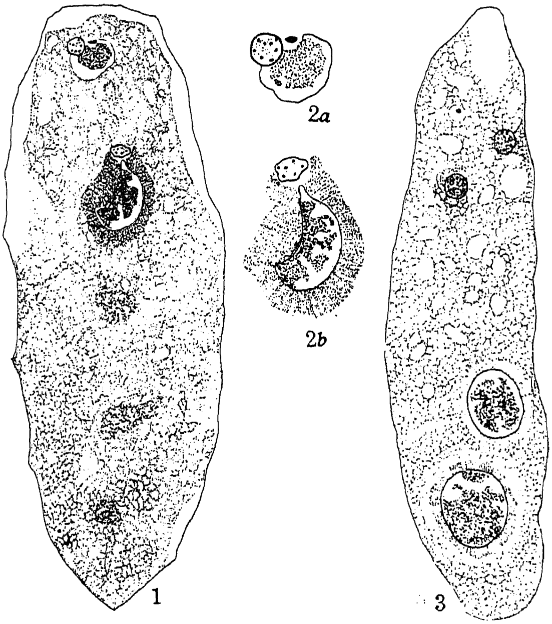

FIG. 1.—L. S. egg, showing 'double fertilisation". × 210.

FIG. 2, *a*. *b*.—A part of the same enlarged to show the male nuclei in contact with the ventral canal nucleus and egg respectively. × 320.

FIG. 3.—L. S. egg, showing 2 primary proembryonal nuclei at the basal end and 2 nuclei derived from the fertilized ventral canal nucleus at the upper. × 210.

my disposal several slides showing proembryonal stages. The nuclei of the jacket cells do enter the egg occasionally, but in this preparation there was no evidence of this kind. The only plausible explanation seems to be the last one. A more or less similar stage was once noted by Nichols[9] (1910) in *Juniperus*.

It seems that in those cases where both the male nuclei from a pollen tube are functional and the ventral nucleus is not too ephemeral, such cases of "double fertilisation" may be of frequent occurrence. I am, however, not inclined to attribute any phylogenetic significance to this phenomenon. It seems to be the natural outcome of a tendency towards fusion between any two nuclei of opposite sexual

potencies. The condition is *not* comparable with that in Angiosperms, where we have two polar nuclei resulting in 'triple' fusion.

Further details will be given in a fuller paper which will be published elsewhere.

In conclusion, I take pleasure in acknowledging my indebtedness to Dr. P. Maheshwari for help and guidance and for his kindness in making over to me his slides of *Ephedra foliata* on which this study has been based.

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Dacca,
May 19, 1940.

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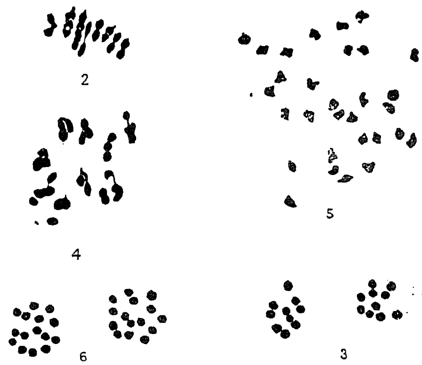
Autotriploidy in *Toria* (*Brassica campestris* L.)

THE only instance of autotriploidy in the genus Brassica is that reported by Morinaga and Kuriyama[1] in rape (*B. napella*) which has $n = 19$ chromosomes. At the Botanical Section of the Imperial Agricultural Research Institute, New Delhi, where a large number of cultures of the cultivated Brassicæ are being studied, two triploid plants were discovered in two different cultures of *toria* (*B. campestris*). The triploid plants were bigger than the diploids and had rather thick leaves and stems. The flowers were also bigger than the normal with broader petals, stouter anthers and styles (Fig. 1). The anthers dehisced easily and the pollen grains were of varying sizes; the pollen sterility was about 40 per cent. The plants did not set seed when selfed—this species being self-sterile—but yielded a good amount of seed under conditions of open pollination.

The pollen meioses of the triploids and diploids were studied by acetocarmine smears. The diploid showed ten bivalents at diakinesis and metaphase I (Fig. 2) and two groups of ten univalents each at metaphase II (Fig. 3). The two divisions in the diploid were carried out regularly and the pollen grains formed were of uniform size and stained well with acetocarmine. In the majority of P.M.C.s in the triploids, at diakinesis, the chromosomes

1. *(Left)* Diploid; *(Right)* Triploid



were found as trivalents, bivalents and univalents in varying proportions. In a few cases, however, the maximum association of ten trivalents was found in each cell. Fig. 4 illustrates a cell in late diakinesis with $8^{III}+2^{II}+2^{I}$ which is the most common association found

in the triploids. At metaphase I the trivalents and bivalents line up at the equator while the univalents lie outside the spindle nearer to the poles. At anaphase, the trivalent chromosomes disjoin into their components and one travels to one pole and the other two to the opposite pole. Fig. 5 illustrates an anaphase in one of the triploids. The univalents are generally included in the daughter nuclei without division, although occasionally in some cells, they are seen to divide late on the spindle. At anaphase II, the most common distribution of the chromosomes is 16 and 14, although 15 and 15 is found in several cells (Fig. 6). The second division is less irregular and pollen grains are formed as triads, tetrads and pentads. The seeds set on these plants by open pollination will be sown next season for study of the chromosome distribution in the viable progeny.

The exact mode of origin of spontaneously occurring triploids is not usually known but is believed to be due to the union of a haploid gamete with a diploid gamete or the fertilization of the haploid egg by two male nuclei. In the genus Brassica where frequently purely maternal offspring result from interspecific crosses Noguchi[2] has shown that the egg develops by diploid parthenogenesis following the stimulation by the male nucleus which ultimately disintegrates. U[3] who obtained triploid hybrids in interspecific crosses with Brassica, involving the duplication of maternal chromosomes in some and paternal chromosomes in others, considers that in the former case the egg cell which was stimulated to an apomictic development by the presence of the male nucleus, fused with the latter after doubling its chromosomes. He also thinks that the extra paternal chromosome set in some of his hybrids must have resulted from the fertilization of the haploid egg by two male nuclei. Our experience with interspecific crosses in Brassica has clearly shown that pseudogamy is of frequent occurrence. In several of our interspecific crosses, purely maternal offspring has been obtained from crossed seeds. In one instance 64 seeds obtained by crossing *toria* (*B. campestris*, $n = 10$) with *rai* (*B. juncea*, $n = 18$) gave rise to 15 plants of which 14 were like the mother and one was a triploid hybrid with 38 chromosomes made up of two sets of maternal and one set of paternal chromosomes. This case, obviously is similar to those reported by U, and the origin of the triploid may be due to the fusion of the male nucleus with the egg after doubling of its chromosomes. This appears possible considering the wide prevalence of pseudogamy in the genus and the absence of the formation of unreduced gametes in the parent species. In this connection, it would be of interest to know if autotriploids in pure species could also arise by this means, apart from dispermy, where no foreign element is present to stimulate the apomictic development of the egg. We have been able to get a few seeds from *toria* plants by emasculating the flowers in the bud stage and bagging them without pollination and all the seeds so obtained gave rise to plants exactly like the mother. It therefore seems possible that stimulation by a foreign nucleus is not always necessary for the apomictic development of the egg in at least some cases in the Brassicæ and that autotriploids may arise in a similar way as hybrid triploids. This subject is under detailed study.

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New Delhi,
April 30, 1940.

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Perennation in *Oedocladium operculatum* Tiffany

Œdocladium operculatum Tiffany is the commonest species of *Œdocladium* in the Kumaon hills. Originally it was found growing in the form of dark-green velvet-like covering on sandy soil around the temple building of famous Baghnath temple at Bageshwar on

11th September 1939. Later on it was found growing in large masses in the compound of the District Board Dak Bungalow at Kapkot, on the Pindari Glacier route at an altitude of 3,750 feet above sea-level.

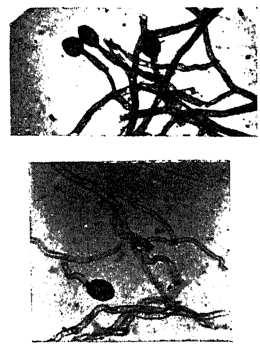
Vegetative cells of the subaerial green portion are 12–14μ broad, 3–8 times as long, each containing a reticulate chloroplast bearing 2–4 pyrenoids. The cells of the subterranean part are brown in colour, are 6μ broad and 5–16 times as long.

This alga is monoecious, oogonia are always single, terminal in position, oval in form, and open by a superior lid. Oogonia are 28–34μ broad and 32–45μ long. Ripe oospores are 24–28μ broad and 32–36μ long, and are yellow or yellowish-brown in colour almost completely filling the oogonium. Spore-wall is scrobiculate with pits 1μ in diameter. Antheridia are hypogynous, usually 2, rarely 3, and are squarish, 8μ $\times$ 8μ. The walls of empty antheridia are delicate and are usually found crushed.

Resting Buds.—The interest of this form however lies in its peculiar underground resting buds. Perennation in this form takes place not only by means of oospores which are subaerially produced, but also by means of subterranean resting bodies of three different types.

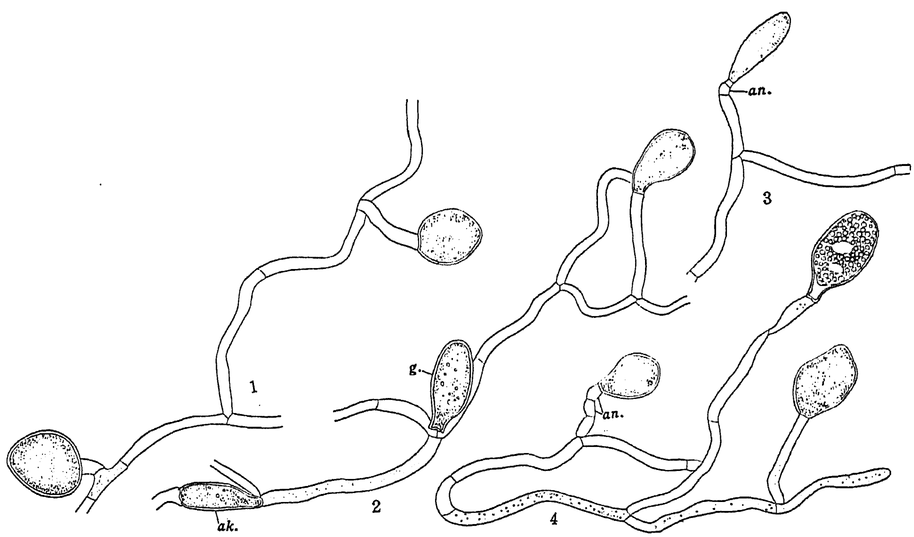
1. *Akinetes.*—These are formed by the storage of starch and other food-materials in some of the shorter cells of the underground filaments. These are recognised by their intercalary position and fusiform appearance (Text-Fig. I: 2).

2. *Gemmæ.*—Very rarely akinete-like thick-walled bodies are found at the nodes of the sub-



Oedocladium operculatum Tiffany.

1. Subaerial part bearing oogonia.
2. Shows rhizoidal part bearing a parthenospore or a modified oogonium. Both about $\times$ 80.



Text Fig. I.—*Oedocladium operculatum* Tiffany. Various kinds of resting buds, Figs. 1, 3 and 4 show parthenospores or modified oogonia with vestigial antheridia (*an*), 2. Shows an akinete (*ak*) and a gemma (*g*). All $\times$ 210.

terranean cells from where branches radiate out in three different directions (Text-Fig. I, 2, *g*). These bodies resemble the underground akinetes described above in form and structure, but differ from them in their nodal position. They resemble the "gemmæ" described by Stahl in *Œdocladium protonema*.

3. *Parthenospores*.—Much more common than the resting buds described above are yellowish-brown bodies which may be described as parthenospores, or arrested and transformed oogonia. They differ from the 'akinetes', and 'gemmæ' in their terminal position. Usually they are pear-shaped in appearance (Text-Fig. I: 1) and rarely club-shaped (Text-Fig. I: 3). They are 40–50μ long and 35–44μ broad, that is, almost of the same size as the oogonia. They are usually full of starch and other food materials, and stain blue-black with iodine. Their morphological nature as arrested and transformed oogonia is evident from their position and size, the presence of vestiges of lids in some cases, and also from the presence of pairs of short cells below them which are reminiscent of antheridia. Chances of fertilisation by the actual escape of sperms under the soil are exceedingly remote, if not well nigh impossible. It is an interesting case of pressing into service subterraneously of an organ which has a sexual function subaerially for the purposes of vegetative propagation and perennation.

In the size of its vegetative cells, shape of its oogonia, and sculpturing of oospore-wall this alga resembles *Œdocladium operculatum* described by Tiffany from Wille's collection of Puertorican algæ, from which it differs only in minor details.

Habit.—On sandy soil at Bageshwar and Kapkot, district Almora, U.P., India, in September 1939 after rains.

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May 6, 1940.

Aecidial-Stage of the Rust of Linseed

There is no record in literature of the occurrence in nature of the aecidial-stage of *Melampsora lini* (pers.) Lév., the rust of linseed, *Linum usitatissimum*, nor has any previous worker reported the germination of its teleutospores, in this country.

During the year 1939-40, the writer carried out germination tests with teleutospores, which were successful, and some inoculations were also made with viable material on seedlings of linseed which produced the aecidial-stage. Inoculations were also made with aecidiospores thus produced, resulting, as expected, in the uredo-stage of the rust under report.

Study of the Uredo-stage: In March 1939, collections of rust on linseed were obtained from Cawnpore, Allahabad and Pusa which contained plenty of uredo and teleuto-material. Uredo-cultures were started simultaneously at the botanical laboratory, Agra College, Agra, and the rust research laboratory at Simla. These cultures were repeated after every three weeks or so. At Agra, no infection could be obtained even in shade after the end of April 1940, whereas at Simla the culture flourished in the green-house as well as in a miniature plot, under natural conditions throughout summer. Even during winter, the rust survived in the miniature plot at Simla. From July to October 1939, all attempts to re-start the culture at Agra with fresh uredo-material obtained from Simla were unsuccessful. Inoculations made in November, 1939, produced good infection and the culture was successfully maintained at Agra in the open till the end of April 1940. These experiments show that the uredo-stage of the rust of linseed cannot stand the heat of summer in the plains.

Germination of teleutospores: As stated above, successful germination of teleutospores of this rust has not been recorded by any previous worker in this country.

A portion of the teleuto-material from collections, referred to above, was kept in a room

in the laboratory at Agra and the rest in a refrigerator. On December 12, 1939, a piece of stem and leaves bearing teleuto-sori, from the Allahabad collection kept in the refrigerator, were soaked in tap water overnight at the room temperature and teleutospores from the same were separated from the tissues with a dancet needle and put on a slide in a moist chamber the following day. The slide was examined every day and on December 18 nearly 60 per cent. germination was noticed and in some cases the sporidia had already been formed. On the next day, sporidia were observed on almost all the germinating teleutospores. All attempts to obtain germination from the material stored in the room at Agra were unsuccessful. Further tests are needed to make sure if teleutospores, kept even in a room in the plains during summer, lose their viability in every case. The tests carried out so far have shown that teleutospores are viable at the time of their formation on the crop in the plains.

Inoculations with germinating teleutospores: Young leaves on seedlings of linseed, raised at Agra, were inoculated with teleutospores that had just started germinating, on January 22, 1940. The plants used in this experiment were raised in a rust-proof seedling house. Spermogonia appeared on January 31, followed by æcidia on February 5, 1940, *i.e.*, 13 days after inoculation. It might be mentioned that no nectar from the spermogonia was mixed in this experiment, nor was it possible for any insect to visit the infected plants as the pot had been kept covered with a double-muslin case throughout. The formation of æcidia without nectar mixing is easy to explain in a case like this because of mass inoculation and the presence of spermogonia very near one another. The range of average maximum and minimum temperatures during the period of the experiment was 63·7°–70·8° and 47°–51° F. respectively, the weekly maximum and minimum temperatures being 77° and 42·5° F.

Inoculations with œcidiospores: Æcidiospores from the æcidia thus formed were put on leaves of seedlings also raised in a rust-proof seedling house on February 22, 1940, and, as expected, the uredo-pustules appeared on February 29.

The above account gives a complete life-history of the parasite under report. As far as the writer can see, the absence of the æcidial-stage in nature in the plains of India is due to the loss of viability of teleutospores due to exposure to very high temperatures after the harvest. Further work should explain the rôle of the teleuto-stage in the hills of India as there is no record of the occurrence of the æcidial-stage from those areas either.

It is not possible to say at this stage whether this rust starts afresh every year in the hills from the æcidia, hitherto unnoticed, or it is also a case of propagation by oversummering uredospores in those areas followed by dissemination to the plains, as recorded by Mehta[1] in the case of wheat rusts.

Several other observations and experiments have been made by the writer on the rust under report and a fuller account will be published elsewhere.

It might be mentioned that the disease under report is one of the commonest crop pests in some districts of the United Provinces and Bihar.

The writer is very grateful to Rai Bahadur Dr. K. C. Mehta for suggesting this piece of work and for the facilities and guidance given during the course of the investigation. Thanks of the writer are also due to Drs. T. S. Sabnis and E. F. Vestal as well as to Mr. R. D. Bose for the supply of material. The writer also wishes to offer his sincere thanks to Mr. H. L. Gulatia for looking after the cultures at the Rust Research Laboratory, Simla.

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Department of Botany,
Agra College, Agra,
May 25, 1940.

[1] Mehta, K. C., *Proc. Ind. Sci. Congress*, 1929, p. 199; *Ind. J. Agric. Sci.*, 1933, **3**, 939; *Scientific Monograph* No. 14, *Imp. Council of Agric. Res., India* (in Press).

Stem-end Rot and Soft Rot of Pineapple in the United Provinces

THE cultivation of pineapple has been successful in the Gorakhpur and Pilibhit Districts of the United Provinces, where this crop is being grown for the past few years. Very little information is available about the local important pests and diseases of this crop. A few fruits purchased at the Cawnpore market, which were reported to have been obtained from Gorakhpur District, showed the incidence of stem-end rot. This disease, which has been recorded from the Philippines, Hawai, Fiji, Malaya and South Australia where pineapple growing is an established industry, is known to do considerable damage, specially if the crop is not properly handled after the harvest.

The symptoms of the disease are easy enough to identify by the naked eye. The stem-end region of the fruit shows a water soaked appearance and gradually sinks down; at the same time a yellow fluid exudes if the fruit is pressed. The fruit stalk is also affected; it becomes soft and later on fibrous. The cut end of the stalk devlops a black powdery appearance, and on splitting it open the black colouration can be followed through it right to the heart of the fruit. Even when a very small area at the stem end is affected the stalk is thoroughly decayed and can be easily pulled away from the fruit.

The fungus responsible for this disease is *Ceratostomella paradoxa* (de Seynes) Dade [*Thielaviopsis paradoxa* (de Seynes) V. Höhn]. This fungus has been reported on sugarcane in Bengal by Butler[1] and in Coimbatore by Subramaniam.[2] It is also recorded on *Cocos nucifera, Areca catechu* and *Borassus flabellifer* by Sundararaman.[3] Several other host plants like sugarcane and pineapple were successfully inoculated by Sundararaman by the same fungus. Evidently, therefore, this fungus is widely distributed in India and is common in the sugarcane growing tracts. Gorakhpur District of the U.P. has a large acreage under sugarcane cultivation but so far the fungus has not been recorded in this locality.

This disease of pineapple has not yet been recorded in India.* No control measures can, therefore, be recommended until local conditions have been carefully studied. Work done in other countries indicates that high temperature, dampness and lack of ventilation favour the progress of the disease. The fungus enters the fruit most frequently through the cut end or other exposed surfaces. It is also capable of penetrating even the uninjured surface if suitable conditions are present. Dickson and others[4] revealed that 75·5 per cent. infection originated at the cut surface of the stem and 22·3 per cent. presumably through side wounds, and that it seldom, if ever, took place except through wounds and bruises.

The control measures in other countries have been mainly directed towards preventing infection at the cut stem end of the fruit. In Hawai[5] the harvested crop is left exposed to the sun for an hour or two to destroy the spores of the soft rot fungus and Higgins recommends the marketing of only such fruits as have the stem shrivelled by drying. Treating the cut end of the stem with antiseptics or cauterisation with hot iron has also proved very effective. Judicious crop rotation and avoidance of intercropping with sugarcane has also proved beneficial.

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Cawnpore,
June 7, 1940.

* Since this was sent for publication it has come to the notice of the author that this disease has been recorded in India by the Imperial Mycologist in the Scientific Reports of the Imperial Agricultural Research Institute, New Delhi, for the year ending 30th June 1939. (Published by the Government of India Press, New Delhi, 1940.)

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A Free Larval Stage in the Life-history of a Fluviatile Gasteropod

ANIMALS living in inland waters, it is well known, are generally characterised by direct development, free larval stages being exceptional and confined only to a few groups. Among the Molluscs, the bivalve *Dreissensia*[1] is the only freshwater form which is known so far to have a free larval stage in its devlopment. *Dreissensia,* however, is a recent immigrant into inland waters,[1] the immigration having taken place in the eighteenth century, when it appeared in the rivers Volga and the Danube.[2]

Recently, in the course of my studies on the Melaniidæ, a purely freshwater family of Gasteropods, I found that there is a free-swimming veliger phase in the life-history of *Melania* (*Radina*) *crenulata* (Desh.). One variety of this species, var. *tirouri,* inhabits the Coleroon River (Madras Pcy.), about eight miles from its mouth. Preston[3] records the occurrence of this variety in the South Pennar (near Cuddalore), Vizagapatam, Andamans, Celebes, and Philippines.

The majority of Melaniidæ are viviparous, and the young are retained in the brood pouch. Moore[4] recorded the occurrence of a brood pouch in the Tanganyika Melaniidæ, *Tiphobia, Tanganyicia, Nassopsis,* etc. Among the Indian Melaniidæ, I have observed a brood pouch in the different species of *Melania, Melanoides* and *Acrostoma.*[5] Speaking generally, and with special reference to the Indian species, the ova are fertilised in the receptaculum seminis, whence they pass into the brood pouch wherein they undergo their complete development. The young are retained in the brood pouch for a considerable time, and at the time of liberation are found to possess well-formed shells, and resemble the adults in all respects excepting size.

During the breeding season the brood pouch is usually found to be fully packed with developing eggs, and young ones with sculptured shells, the latter being more conspicuous. In the case of *Melania crenulata* the breeding season commences about the month of November and extends till the following April. During this period the brood pouch contains *thousands* of developing eggs, and a few veligers just escaped from the vitelline membrane but no juvenile forms. The enormous number of eggs is a remarkable feature, for, in other species like *Melanoides tuberculatus* or *Melanoides scabra,* only a few embryos and young ones, about two hundred at the most, are found in the brood pouch. Further, the histological structure of the brood pouch of *Melania crenulata* is different from that in the other species, for in the latter the epithelium is modified in relation to the nutritional needs of the post-embryonic and juvenile stages. These features, the enormous number of eggs, the absence of juvenile stages in the brood pouch and modification of the brood pouch epithelium, led me to suspect the presence of a free-swimming larval stage in the life-history of *Melania crenulata.*

Accordingly, intensive observations were made in the laboratory and in the field, and I was able to discover a veliger phase of about two weeks' duration, which is spent in active swimming in the river water. In the first instance, about half-a-dozen veligers were found swimming in the water in the aquarium. Subsequently, examination of water from the river revealed the occurrence of a few free-swimming veligers. For observing the complete development, an attempt was made to rear in the laboratory the larvæ that were obtained by cutting open the brood pouch, and liberating those that had escaped out of the egg membrane, but this was only partly successful. I have been quite successful, however, in rearing in the laboratory veligers collected from the river, by using a mixture of sea water and water from the river.

The full grown veliger of *Melania* has the typical form met with in the life-history of marine Gasteropods, and has two velar lobes provided with long cilia by means of which it swims about rapidly. As stated already, the veliger phase lasts for about two weeks. About

the sixth day of free life the rotatory action of the crystalline style begins, and is very clearly discernible.

Yet another interesting feature was observed. My collections of the veligers were made during March–April, and I noticed during this period a remarkable abundance of the larvæ in the river at high tide (the influence of the tides is felt to a little extent in the river at the place where this *Melania* occurs) on the day previous to the full moon as well as on the full moon day and on the following day. Similarly about the time of the new moon the larvæ were abundant, though not to the same degree. As the breeding season was over by the middle of April, I have to wait till the next season for making further observations on this aspect.

The Melaniidæ are considered to have been probably derived from the Cerithiidæ,[6] and are not known until the Cretaceous period. I do not know of any evidence to show that *Melania crenulata* is so recent an immigrant into fresh waters like *Dreissensia*. In its anatomy *Melania crenulata* resembles very closely other Melaniids such as *Melania tuberculatus, Melanoides scabra,* etc. Yonge,[7] speaking with reference to the Tanganyika Melaniidæ suggested that viviparity and brood pouch might be adaptations for penetration into deep water by freshwater Prosobranchs. I do not consider this view to be tenable, for, as Yonge himself noted, a brood pouch is not confined to the forms living in deep waters, and many of the Melaniids in which I studied the brood pouch are inhabitants of very shallow water. In my view the brood pouch seems to be associated with the migration into inland waters. It may be considered as reminiscent of the saline medium of the ancestors of the Melaniidæ (even as the amniotic cavity is associated with the acclimatization of the aquatic vertebrates to land, and is reminiscent of the ancestral aquatic medium). Immigration inland is generally attended with the suppression of the free larval stages. In most of the freshwater Gasteropods the eggs are provided with albumin and usually with a protective jelly also, and the larval stages are passed through in the egg. In the case of most of the Melaniidæ, the brood pouch affords a suitable environment for the later stages of development as the albumin in the eggs of other genera, and as sea water does for the larvae of the marine species. *Melania crenulata* and a few closely related species, as I will show in a later account, probably never ventured far inland, but have remained near the mouths of rivers, and being subject to a certain extent to the influence of tides and a low degree of salinity still liberate veligers into the partly saline medium. But in most other Melaniids, associated with a greater degree of penetration into inland waters and acclimatization to freshwater, we notice a complete retention of the veligers in the brood pouch, wherein they swim freely, and are nourished by the secretion of the brood pouch epithelium. In *Paludomus*[8] we have an instance of a Melaniid in which acclimatization to freshwater may be considered to be perfect, and which has no brood pouch, the eggs being laid in water.[9]

Further investigations are in progress, and I hope to discuss at length, in due course, this and other interesting features of the family Melaniidæ.

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Annamalai University,
Annamalainagar,
May 26, 1940.

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2 Pelseneer, *Mollusca* in *Treatise on Zoology* (edited by Lankester), 1906, p. 264.

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6 Cooke, *Cambridge Natural History*, *Mollusca*, 1913, pp. 17 and 417.

7 Yonge, *Nature*, 1938, **142,** 464.

8 Seshaiya, *Rec. Indian Museum*, 1934, **36,** 209.

9 Ramanan, *Non-marine Mollusca of Madras*, 1900.

The Origin of the Pisiform

WHILE studying the bones of an immature female langur (*Semnopithecus entellus*) it was observed that the pisiform had two centres of ossification, *viz.*, a diaphysial centre giving rise to the major part of the bone and an epiphysial centre for its distal end. This observation appeared significant (Fig. 1). A dissection of

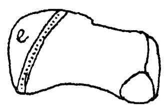

FIG. 1

Pisiform of immature *Semnopithecus entellus*, (left), ×2. Inferior view showing epiphysis, *e*, at distal end.

the wrist of another immature animal and an X-ray photograph (Fig. 2) of an intact limb confirmed the normal presence of an epiphysis for the pisiform in the langur. In an articulated skeleton (of a male adult animal) which the author had previously made, the result of the union of the two constituent parts was seen. The fact that the pisiform bone has in it the elements of a diaphysis and a distal epiphysis has not been recorded previously in this or in any other animal.

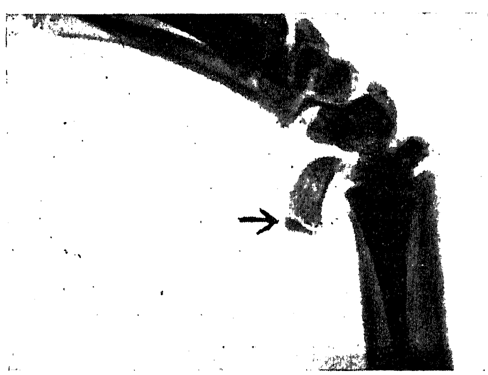

FIG. 2

X-ray photograph of wrist, side view, the arrow pointing to the epiphysis of the pisiform

In the dissected wrist of the langur, the flexor carpi ulnaris muscle was inserted into the epiphysial part of the pisiform whence its prolongations to form the pisohamate and the pisometacarpal ligaments were made out.

The presence of a diaphysis and an epiphysis would lead one to consider the pisiform as a definite skeletal element rather than as a sesamoid bone. According to Keith[1] the M. gastrocnemius in the lower limb corresponds to the M. flexor carpi ulnaris in the upper limb. The insertion of the flexor carpi ulnaris to the epiphysial part of the pisiform is comparable with the insertion of the gastrocnemius to the epiphysial part of the calcaneus. From this it is suggested here, in as much as the primitive carpus and tarsus are similar, that the pisiform appears to be a definite carpal element and that its serial homologue in the tarsus is probably included in the posterior part of the calcaneus.

A fuller discussion on the subject will be published elsewhere.

I wish to thank Dr. P. Kesavaswami, Radiologist, K. G. Hospital, who kindly took the X-ray photograph for me.

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[1] Keith, Sir A., *Human Embryology and Morphology*, London, 1933, 505.

A Lecture Demonstration of Mixed Solvent Action

IT has been observed before that two non-solvents when mixed together may sometimes function as a good solvent for a solute, the case of some forms of nitrocellulose dissolving in a mixture of ether and alcohol forming one of the best examples of this behaviour. De-waxed shellac is mainly composed of a soft resin, soluble in ether and a hard resin (α-lac) insoluble in it. This α-lac when dry is practically insoluble in acetone, methyl acetate, water and glycol. It has however been observed, that when a mixture of acetone and traces of water, or acetone and glycol, or methyl acetate and water, or methyl acetate and glycol, is

added to dry α-lac, the latter goes quickly into solution. This phenomenon can be utilised as a lecture experiment to illustrate mixed solvent action.

(1) α-lac (hard lac resin) prepared by repeated extraction of the soft resin portion of dewaxed shellac by ether, is dried thoroughly in vacuum at about 42° C. for three hours, after which small quantities (about 0·5 grams) of it are taken in two sets of three test-tubes. To one set is added 5 cc. each of dry acetone, water and aqueous acetone (10 per cent. water) respectively, whilst to the other set is added 5 cc. each of dry methyl acetate, glycol and a 1 : 1 mixture of methyl acetate and glycol respectively. It will be noticed that the α-lac in contact with the mixed solvents goes into solution in a minute or so at ordinary temperature whilst with the single non-solvents, no such dissolution takes place even on warming.

(2) As the preparation of α-lac from shellac involves a somewhat laborious process for ordinary demonstration experiments, dewaxed shellac which is available in the market could be dried under vacuum as before and experiments conducted with it in the same manner. Experiment with methyl acetate-glycol mixture is easier to demonstrate since the shellac need not be very carefully dried and the sensitivity of the experiment to a small quantity of impurities is far less. The solvents must be dried by the ordinary laboratory methods before using.

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Detection of Adulteration in Ghee by a Study of its Fluorescence

The property of ghee (clarified butter-fat), to produce a characteristic fluorescence under the influence of ultra-violet light was utilised independently by Jha[1] and Muthanna and Mukerji[2] to evolve a method for detecting its adulteration. The former reported results of a qualitative study covering a number of samples of ghee and its common adulterants. The latter while confirming the qualitative observations, developed a quantitative method for measuring the intensity of the fluorescence so produced. Using a Pulfrich photometer these authors obtained 'standard curves for the common adulterants of ghee'. In these studies fresh samples of clarified butter fat were used.

As pointed out previously in a note,[3] there are a number of factors that require consideration in any study purporting to deal with the quality of butterfat, and as long as one is in the dark regarding the identity of the particular substance or substances responsible for the reported fluorescence in ghee, all factors which influence its behaviour such as the season, feed, period of lactation, breed and species peculiarities and others need careful attention. Equally important is the question of the age of the sample. The work so far reported on the subject goes to show that under certain given conditions, the age of the sample exerts considerable influence on the known "butter constants". Added to these are the commercial practices in this country of colouring almost the bulk of the marketed ghee and butter with a variety of artificial colours.

Since reports regarding the typical fluorescence of ghee were encouraging, it was considered of interest to study the limitations, if any, imposed on the method suggested by Muthanna and Mukerji (*loc. cit.*) by the factors mentioned in the foregoing. The present communication is confined to the results of a study of the influence of the age of the sample and the artificial colours. Work is in progress concerning the other factors.

A number of ghee and butter samples which were received in the laboratory for examination were subjected to the fluoremetric analysis, after their regular analysis was finished. Some of these samples were fresh and genuine and the others were old and were stored in the laboratory for the last sixteen months. One sample was nearly nineteen months old,

Samples of crude groundnut oil and hydrogenated vegetable fat were also similarly analysed in the ultra-violet. "Laktone" butter colour, which is commonly used by the dairy industry for imparting a pleasing tint to butter, was also included in the study. Measurement of the intensity of fluorescence in each case was made in a Pulfrich photometer having an improvised ultra-violet attachment.

A solution of quinine sulphate (880 γ per litre) served as the standard. Ghee has a greenish fluorescence, its adulterants having blue or shades of blue. It was therefore considered appropriate to sift the resulting fluorescent light through the respective colour filters so that only these components of the ultra-violet light which are considered characteristic of ghee and its adulterants, alone are available for measurement. For this purpose filters 10 and 11 which allow wave-lengths 520–540 Å and 450–490 Å respectively, supplied with the instrument were employed. Light from the standard and the experimental solutions as it emerges from these filters was then matched in the instrument. The experimental solution in each case was made up of one volume of melted fat and three volumes of chloroform. The results are given below.

Serial No.	Substance analysed.	Age of the sample.	Colour of fluorescent light as seen with naked eye.	Strength of blue component (standard at 100).	Strength of green component (standard at 100).	Ratio of blue to green.	Remarks on quality of sample.
1	Butter	15 months	Bluish white	100·0	61·0	1·65	Genuine
2	Ghee	2 weeks	,, ,, bright	20·0	12·0	1·66	75 per cent. f.f.
3	Butter	2 ,,	Yellowish green	36·0	10·0	3·6	Genuine
4	Ghee	18 months	Bluish white	46·0	22·0	2·1	,,
5	Butter	15 ,,	,, with a tinge of green colour	14·0	5·0	2·8	,,
6	Ghee	8 ,,	Light blue	11·0	4·0	2·75	*Adulterated
7	Ghee	11 ,,	Blue	11·7	7·0	1·7	Genuine
8	Ghee	9 ,,	Bluish white	9·0	7·0	1·3	*Adulterated
9	Ghee	10 ,,	,,	13·0	9·0	1·4	,,
10	Ghee	11 ,,	,,	25·0	12·5	2·0	Genuine
11	Ghee	9 ,,	,,	16·0	7·5	2·1	20 per cent. f.f.
12	Ground nut oil (Crude)	13 ,,	Blue	100·0	62·0	1·65	..
13	Hydrogenated vegetable fat	12 ,,	Bright purple-blue	47·0	30·0	1·6	..
14	"Laktone" : Groundnut oil	..	Bluish white with green tint	150·0	75·0	2·0	..
15	"Laktone"	..	Yellowish	Faint	Nil	..	..

* The adulterant is not more than 15%.   f.f. Foreign fat

The above results clearly show that the green or greenish fluorescence which is considered typical of ghee is not so in fact. A combination of the blue fluorescence of crude groundnut

oil and the yellow of the "Laktone" butter colour produces the same greenish tint that is associated with ghee (*cf.* samples 5 and 14). This observation is of considerable importance because it reveals that the green fluorescence is no criterion of the genuineness of the ghee.

To see if any quantitative relationship exists between the intensities of the blue and the green components, the ratios of blue/green were calculated in each case. This value (*cf.* column 7), too, fails to indicate any bearing on factors like age and purity of the sample. It therefore seems that even if steps were taken to remove the artificial colour from the fat prior to the analysis, the method promises no hope.

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[1] J. B. Jha, *J. Ind. Chem. Soc.*, *Ind. and News Edn.*, 1939, **1**, 159.

[2] M. C. Muthanna and B. Mukerji, *Curr. Sci.*, 1940, **9**, 120.

[3] G. Narasimhamurty, *Curr. Sci.*, 1940, **9**, 235.

Review of Recent Investigations at the Punjab Irrigation Research Institute

I HAVE read the review of the Punjab Irrigation Research Institute, Research Publication No. 23, Vol. II, 1939, which appears on pages 202 and 203 of the April issue of *Current Science*. Your reviewer has given an excellent summary of the Punjab investigations and the conclusions that have been reached by Dr. Bose and Dr. Malhotra. I feel, however, and the two authors of the publication agree with me, that your reviewer has not given sufficient credit to Mr. Lacey, whose work led directly to these investigations.

Mr. Lacey's work undoubtedly re-opened the question of silt in its relation to regime conditions and he has made notable contributions to this subject. During the past ten years, the Research Officers of the Central Board of Irrigation have met frequently to discuss the subject. The work which has been carried out in the *Irrigation Research Institute*, Lahore, has arisen out of the discussions between Mr. Lacey and the Research Officers of the Punjab which took place at these meetings.

The notation adopted in the Punjab publication under reference is that of Mr. Lacey except that '*m*', the mean diameter of the silt on the bed, is used instead of '*f*', Mr. Lacey's silt factor. I would like to say that Mr. Lacey's work formed the starting point for the investigations carried out in the Punjab, although the methods of investigation and the apparatus connected with it have been devised by the Research Officers of the *Irrigation Research Institute*, Lahore. I am sure your reviewer will not object to my drawing attention to the valuable work of Mr. Lacey.

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Lahore,
May 4, 1940.

THE NEUTRALISATION VALUE OF GHEE (BUTTER-FAT)

BY

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THE best known test for the genuineness of butter-fat is a determination of the Reichert Value (R.V.). Probably there is no public analyst who does not use this test, at least for sorting purposes; while many do little or no further investigation if the value is normal.

In countries where butter is prepared from the milk of well-kept herds of cattle, the R.V. will detect quite moderate adulteration, the butter from such herds being only subject to small seasonal variations. In India the problem is very different. Ghee is prepared from the milk of animals—usually buffaloes—kept under very varying conditions, both climatic and controllable. There are herds that are well fed in a temperate climate; others live in the tropics and get little food beyond such pasture as they can find on waste land. It is not surprising to find that, with animals maintained so differently, the composition of the butter-fat derived from them does not show the constancy of composition of that from dairy herds; in fact buffalo ghee can yield R.V.'s varying from below 20 to over 40, though most samples come within a more restricted range. The R.V. varies with the proportion of Butyric Acid and it is an unfortunate fact that most of the other tests that are commonly used have a similar dependence, *e.g.*, Kirschner, Saponification, and Ave-Lallemant values. Specific tests for certain adulterants, *e.g.*, Polenske test for coconut oil, are of great value in special cases but in the absence of an identifiable adulterant the analyst is faced with a difficult task when a sample gives a R.V. slightly below normal. The figure is low because there is a deficiency of butyric acid and he has to decide whether this deficiency is due to abnormality, or adulteration with a fat that does not contain butyric acid.

It is very seldom that the saponification value will give useful information for when butyric acid, an acid of low molecular weight, is deficient, the saponification value will automatically fall. The refractive index will sometimes give a hint, but here again butter-fat with a low R.V. tends to have a high refraction. When an adulterant is present it is commonly of vegetable origin and then the sterol acetate will give positive information, but the test takes a lot of time and involves an elaborate technique; further, it will not detect animal fat.

It occurred to the author that the neutralisation value (N.V.) of the fatty acids might be of value. At first sight it might be thought that this figure would parallel the saponification value. This is not so since the latter is determined on the whole fat, including glycerine butyrate, while the neutralisation value depends on the molecular weight of the *insoluble* fatty acids; butyric acid is miscible with water, accordingly it can have no direct effect on the figure. The test has proved to be of considerable value and to give definite evidence of adulteration in a number of doubtful cases.

At the beginning of the investigation it was found that, estimated according to text-book instructions, the value is useless. To prepare the fatty acids the usual instruction is that, after saponification and acidification, the acids shall be "boiled till clear". As butter-fat contains glycerides of fatty acids of low molecular weight such as Caproic and Caprylic which, though but sparingly soluble in water, are freely volatile in steam, the figure obtained will depend on the time of boiling. That the effect is by no means negligible is shown by the following figures obtained on the same sample of ghee:—

		N.V.
Fatty acids cleared by method	described below	214·1
Do.	boiling for 1 hour	212·3
Do.	boiling for 2 hours	211·0

For preparing the fatty acids without undue loss of volatile acids the following technique has been worked out:

About 10 grams of the clear fat is saponified with 30 mils. glycerol-soda (84 grams NaOH dissolved in water and made up to 210 mils.,

and glycerine added to make 1 litre) in a 500 c.c. flask. The product is dissolved in 150 mils. hot water and the flask is placed on a boiling water-bath and fitted with a short air-condenser (about 8 inches of narrow tubing) which is covered with a small inverted test-tube. The flask is then placed on a boiling water-bath and, when it has reached a steady temperature, it is acidified with 10 mils. sulphuric acid of a strength (approx. 17% by volume) such that 9–9·5 mils. will neutralise the glycerol soda. *N.B.*—The strength of the acid must be checked by a blank titration using methyl red as indicator; no indicator should be added to the soap solution. The flask is kept on the water-bath for 3 hours (± 10 minutes) with occasional shaking by rotation to assist clarification. At the end of this time it will be found that the fatty acids are clear. About 50 mils.—which includes all or nearly all the fatty acids—is poured off into a 50 mil. separating funnel; the acids are separated and washed three times with 25 mils. of hot water; they are then filtered in a steam oven into a small beaker. 4·9–5·0 grams of the filtered acids are now transferred with a suitable warm pipette to a weighed 250 mils. extraction flask; weighed to an accuracy of 2 m.g.; dissolved by warming in 50 mils. neutral (to thymol-blue) 90% alcohol and titrated with freshly prepared NaOH of approximately N/2 strength using 1 mil. 0·04% thymol-blue as indicator. The N.V. is then calculated as milligrams of KOH required to neutralise 1 gram of the fatty acid. When a number of determinations are being made it has been found convenient to put the flasks containing the soap solutions on a large water-bath and when—after say one hour—they have attained a uniform temperature, to acidify them at intervals of 5 or 6 minutes—according to the operator's speed of working,—so that the fatty acids can be separated and washed successively after precisely three hours.

Experience has shown that prolonged heating lowers the figure. A sample of ghee gave neutralisation values by the method described of 215·8 and 216·0; two more determinations in which the flask was heated for an additional 10 hours, gave 212·5 and 212·6. The fall in N.V. appears to be due to decomposition of oleic acid. A specimen (several years old) of Merck's Oleic Acid was heated with water (slightly acidified) for 1 hour and 10 hours, washed as usual and the N.V. determined.

After 1 hour the N.V. was 189·3.
„ 10 hours „ „ 182·1.

Unless the flask is rotated occasionally it will sometimes be found that the fatty acids are not clear after three hours. This shaking does not have any effect on the N.V. The N.V. of a sample of ghee was determined in the usual way; it was then repeated, the flask being shaken frequently and vigorously during the three hours' heating. The value was unaltered.

Duplicates should not differ by more than 0·2, but, to get figures as reliable as this, the titration must be carried out with great care and the NaOH solution carefully standardised. In this laboratory the burette is read with a telescopic burette-reader supplied by Messrs. Arthur Thomas & Co., Philadelphia. It has great depth of focus, so that the graduations at the front and back of the burette can be clearly seen at the same time, thus avoiding parallax; readings by estimation are possible to 0·01 mil. and titrations are recorded to this accuracy. For each set of determinations the N/2 NaOH is checked against pure Potassium Hydrogen Tartarate (about 3·45 grams) or Potassium Hydrogen Phthalate (about 3·75 grams); thus all burette readings come between 40 and 45 mils. and minor burette errors are eliminated. As the neutral point is approached the yellow colour of the indicator becomes greenish. There is a point at which all yellow has disappeared but the solution cannot be said to be a pure blue; possibly slate-green best describes it. This point, which is taken as the neutral point, can be judged with great precision; 0·01 mil. N/2 alkali or acid gives an unmistakable change.

The following table summarises the neutralisation values determined on samples of butter-fat prepared in the laboratory from milk samples taken in the Madras Province, and submitted for analysis as buffaloe milk under

Neutralisation value	Number of samples	Reichert Value		
		Mean	Maximum	Minimum
207·0	1	18·9		
207·6	1	23·3		
208·5	1	20·4		
208·9	1	20·9		
209·0	1	20·4		
209·3	1	21·1		
209·4—209·9	7	24·1	25·9	22·4
210 0—210·9	13	24·2	32·0	18·6
211·0—211·9	17	25·8	29·0	23·5
212·0—212·9	15	24·8	28·9	22·3
213 0—213·9	5	26·2	29·7	24·1
214·0—214·9	6	27·5	30·1	23·8
215·0—215·9	4	27·2	30·3	21·3
216·0—216·9	3	28·1	31·8	26·2
217·0—217·9	..	..		
218 0—218·9	1	23·5		
219·0—219·9	1	27·3		
Total ..	78			

the Prevention of Adulteration Act. Samples were usually between 15–20 grams. *N.B.*— The average Reichert Value for Madras butter-fat is higher than the table suggests since for the greater part of the investigation the neutralisation value was only determined on fats giving R.V.'s of below 25; later a number of samples with higher values were included.

The 6 samples that gave figures below 209·4 are given separately, the others have been grouped. It will be seen that though there is some tendency for high N.V. figures to be associated with high R.V., the figures do not parallel each other as do the Saponification Value and R.V. A sample with R.V. 32·0 had N.V. 210·2 while for another sample with R.V. 21·3 the N.V. was 215·0. Two samples of buffalo carcass fat gave N.V.'s 202·6 and 202·9. Two samples of vegetable product 194·8 and 196·7.

As with the R.V. there are a few abnormal figures but it is necessary to take into consideration that these figures were obtained on fat derived from only small quantities of milk and that in the bulked ghee as sold on the market such ghee would be mixed with ghee giving higher figures. In the author's opinion the figures suggest that a sample of bulked ghee giving a figure below 209 is almost certainly adulterated and that any figure below 210 is highly suspicious.

The value of the test is shown by the following table which gives particulars of a number of samples submitted for analysis under the

Sample	R.V.	Butyro Re-fractometer reading at 40°C.	Melting point of Sterol Acetate (recrystallised twice)	N.V.	Opinion
A	21·0	44·7	121·6	209·6	Adulterated with vegetable fat
B	21·7	43·0	115·0	215·9	Genuine
C	22·1	44·1	114·8	208·6	Adulterated with animal fat
D	22·2	43·7	115·0	215·8	Genuine
E	22·6	43·5	115·0	207·1	Adulterated with animal fat
F	23·0	43·4	115·0	210·5	Genuine
G	23·2	43·8	115·0	209·0	Doubtful, probably adulterated with animal fat
H	23·9	43·7	115·0	210·9	Genuine
I	23·9	44·1	117·4	210·4	Adulterated with vegetable fat
J	24·1	44·8	123·0	206·9	do
K	24·3	44·8	120·8	208·4	do
L	25·3	41·5	115·0	222·8	Genuine
M	25·6	43·1	115·0	212·7	do
N	25·9	44·5	115·0	212·4	do
O	25·9	44·7	123·4	208·8	Adulterated with vegetable fat
P	27·1	44·9	122·6	208·9	do
Q	27·3	45·3	121·4	206·7	do

Madras Prevention of Adulteration Act on which both sterol acetate M.P. and N.V. determinations were made.

Of the seven samples that gave a positive sterol acetate, 5 could be condemned on the N.V. alone. One gave a figure between 209 and 210 and would be put aside for further investigation. The test did not detect the adulterant in sample I; the sterol acetate M.P. suggests that little was present. Of the remaining 10 samples, none of which contained vegetable fat, two were classed as adulterated and one was given the benefit of the doubt though it was probably adulterated; the others were passed as genuine.

In addition to the advantage that adulteration by animal fat can often be detected, the test has been found of special value at the present time since it often detects adulteration with vegetable fats without resort to a sterol acetate test, thus conserving stocks of digitonin, which is, at the moment, almost unobtainable.

REVIEWS

James Gregory Tercentenary Memorial Volume. Edited by H. W. Turnbull. (Royal Society of Edinburgh. G. Bell & Sons, Ltd., London), 1939. Pp. xi + 524. Price 25*s*.

"It is proper to record that on a July day in 1938, three hundred years after the year from which this story dates, there was gathered in the library at St. Andrews, where Gregory worked so long, a company of their mathematical descendants, distinguished guests from the world of science, from the Cambridge of Newton, the Paris of Cassini, the Germany of Leibniz, the Flanders of Huyghens, and the New World of America, assembled in a Scotland where mathematics is still pursued for its beauty and its truth. Let us, in our respective Universities, hold fast to this tradition of fellowship and of devotion to learning and thus honour the name of James Gregory." This quotation from the Tercentenary Volume finely expresses the spirit that has animated Prof. Turnbull, and his collaborators in their labour of love undertaken to present the genius and mathematical intuition of Gregory in its true and proper perspective. Prof. Turnbull has succeeded in showing conclusively that Gregory discovered Taylor's theorem, that his work is substantially independent of the contemporary work of Newton, and that he is virtually one of the independent founders of the calculus—achievements which entitle Gregory to a very high rank in the heirarchy of mathematicians.

A biographical sketch of Gregory, followed by short accounts of his scientific contemporaries, serves to provide the background against which the detailed description of Gregory's work is to be viewed. This description is prefaced by an impartial estimate of the mathematical discoveries of Gregory. Next follows what is perhaps the most important part of the work, *viz.*, the correspondence of Gregory, specially that with Collins. The letters of Collins are published here for the first time, and serve to bring out new facts about Gregory's work in relation to the work of contemporary mathematicians. The correspondence of Gregory alone takes up nearly sixty per cent. of the space of the volume. Also most of his original manuscripts are published here for the first time, and arranged according to subjects. The correspondence and the manuscripts have been carefully examined by the editor, and their mathematical importance elucidated in a series of illuminating notes and running commentaries which are of the greatest help to a proper appreciation of Gregory's work.

The last part of the Volume consists of contributions from distinguished mathematical historians of Europe dealing with the published works of Gregory and other aspects of his scientific life.

Some of the important letters and manuscripts of Gregory might be noticed here. One of the most interesting of these is letter No. 39 (p. 168) in which series expansions are given for $\tan^{-1} x$, $\tan x$, $\sec x$, $\log \sec x$, $\log \tan (\pi/4 + x/2)$, $\sec^{-1} (\sqrt{2\, ex})$ and $2 \tan^{-1} \tan h\, x/2$. As shown by Turnbull (see also p. 356) this letter shows clearly that Gregory actually used Taylor's theorem for all the functions except the first, and it is perhaps an irony of fate that the series of $\tan^{-1} x$, after which Gregory is best known, was obtained without using Taylor's theorem but perhaps by integrating the power series for $(1 + x^2)^{-1}$! Letters Nos. 29–31 (p. 118–33) which are explained by copious notes of the editor support Gregory's claim to the discovery of the binomial theorem. Letter No. 53 (p. 230) contains what is virtually D' Alembert's convergence test. Manuscript No. 19 (p. 386) gives a method of attack on the solution of the quintic equation which if pursued would have showed the impossibility of the proposed method, but brings out, nevertheless, "the workings of a mind possessing deep insight into polynomial structure". The letters on pages 251–75 show his interest in astronomical problems, and how his work overlapped that of Newton regarding the construction of reflecting telescopes. Manuscript No. 52 (p. 450) in which Gregory raises searching questions on the nature of light twenty years before the publication of the *Principia* reveal a very acute and inquiring mind. More examples could be given from the veritable mine explored by Prof. Turnbull to show that there was no branch of mathematics or natural philosophy of

Gregory's time which he did not enrich with his penetrating researches.

The Gregory Tercentenary Volume is undoubtedly a notable contribution to the history of mathematics. B. S. M.

Portraits of Famous Philosophers who were also Mathematicians with Biographical Accounts. By C. J. Keyser. (The Scripta Mathematica, New York), 1939. 12 Portraits. Price $3.00.

This portfolio consists of twelve portraits *viz.*, those of Pythagoras, Plato, Aristotle, Epicurus, Bacon, Descartes, Pascal, Spinoza, Leibniz, Berkley, Kant, and C. S. Pierce, and is accompanied with interesting biographical sketches of Prof. C. J. Keyser of Columbia University. The portraits are beautifully reproduced from different collections, in some cases being pictures of ancient statues, and in the cases of Pythagoras and Bacon the pictures are merely the artist's impressions. It might, however, be mentioned that the portrait of Descartes is not so striking as that in D. E. Smith's collection of portraits of famous mathematicians.

A good plan to study the portraits is first to read the biographical sketch, then take a long and deep look at the pictures, close the eyes for a moment, and return suddenly to the portraits. One can thus hardly fail to escape the thrilling feeling of having suddenly come face to face with the greatest minds of all time. The sketches by Prof. Keyser are brilliantly done, and up to the standard that one expects from his vigorous pen. He has excelled himself in the short biographical account of Leibniz.

Of recent years there has been a tremendous surge of general interest in science, and accompanying it a wholesome curiosity to know more about the life and personality of the men who made science. Among this band of great men the philosopher-mathematicians have played a supreme part in the evolution of scientific, mathematical and philosophic thought. This set of fine portraits, enriched by Prof. Keyser's short sketches, is bound to be of the highest educative value. B. S. M.

Two Dimensional Potential Problems Connected with Rectilinear Boundaries. By B. R. Seth. (Lucknow University Studies No. 13), 1939. Pp. 124.

This small brochure of nearly hundred pages is a connected summary of the subject in question with special emphasis laid on the problems which the author himself has been tackling for a number of years. The mention of rectilinear boundaries at once brings up to mind the classical Schwarz-Christoffel theorem of conformal representation, and the author has fully exploited this method by generalising it in a number of directions. He has besides shown the utility of other methods like that of images and of conjugate functions. A special feature of the author's work is a careful examination of the form of solutions near an angular point, a case which is generally not treated rigorously. A short historical introduction followed by a statement of the problem with the associated general theory carefully presented, and finally a series of interesting applications to special cases all go to make up a valuable contribution to this branch of potential theory. B. S. M.

Introduction to the Theory of Functions of a Real Variable. By S. Verblunsky. (Oxford University Press), 1939. Pp. xi + 169. Price 12*sh.* 6*d.*

This is a compact and well-written text-book, but limited in scope, covering roughly the course in analysis of the honours standard of our universities. Taken along with classical text-books such as Bromwich, de la Vallee Poussin, Casàro, etc., it will be a good text-book for honours courses.

K. S. K.

Photography by Infra-red; Its Principles and Applications. By Walter Clark. (Chapman and Hall, Ltd., London), 1939. Pp. 397. Price 25*sh.*

All scientific workers who use photography as a tool in their research work, will find it profitable to go through this authoritative and very readable book on photography by infra-red by a member of the staff of the Kodak Research Laboratories. Besides discussing the fundamentals of the subject in a clear and simple manner, the book provides in a collected form a large amount of valuable information about methods of practice. Many workers would like to have the book on their shelf for frequent reference.

Although the infra-red part of the spectrum was discovered by Sir William Herschel as early as 1800, it was only in the last decade of the nineteenth century that a

photographic emulsion was prepared which was directly sensitive to the extreme red and near infra-red. Since then, and particularly after the last Great War, great progress has been made in the study of sensitising dyes of the multi-carbocynine class, and plates sensitive up to 13,500 Å are now commercially available. Two reasons prevent a further practical extension of this limit, one being the presence of "dark space radiation" in sufficient quantity to affect the silver halide grain and the second being the intense absorption exercised by even minute quantities of water vapour. The importance of the first is convincingly shown by some striking photographs taken in total darkness using the heat radiation from an electric hot iron or an under-run electric heater and reproduced in the book. In the region of still longer waves, other methods, mainly indirect, have to be employed. Mr. Clark gives a summary of these other methods, including the volatilisation method of Czerny and his co-workers and the electron-image tube method of Zworykin and Morton.

The application of the method of photography by infra-red for various special purposes is described, for example, the photography of distant landscape through haze or fog, aerial photography for surveying, the examination of pictures and documents, the photography of subcutaneous veins or other structures for medical purposes, photomicrography, etc. In most of these applications, the superiority of the infra-red over visible radiation depends essentially on the much smaller scattering and greater penetration of the former in media containing small particles in suspension. The increase in penetration of fog or haze will naturally be most evident in cases where the scattering particles are small in comparison with the wave-length. When the fog or haze appears white in colour, no appreciable increase in penetration can be expected.

The book contains two very useful chapters on sources of infra-red radiation and on optical characteristics of materials and is provided with full name and author indexes.

K. R. R.

Osmotic Regulation in Aquatic Animals. By August Krogh. (The University Press, Cambridge, 1939. Pp. ii + 242. Price 15*sh.*

In sea and fresh water, there exist a vast and bewildering variety of fauna. These animals are normally permeable to water which constitutes their environment. In spite of this circumstance, it is well known that the concentration of their body fluids differs from that of the surrounding water. The cells, while they maintain an osmotic equilibrium with the medium in which they are bathed, exhibit significant differences with regard to the concentration of single ions. What is the mechanism through which these differences are brought about? Prof. Krogh, in this volume, has presented experimental data to clarify this problem. For a large number of organisms, it has been found that the regulation of ionic concentration is accomplished essentially by an active transport of definite ions through certain cells into and out of the body fluids. In a number of cases, the presence of special mechanisms has been demonstrated by which ions, certain organic substances and sometimes even water, are transported in one direction only and may be moved against gradients and potentials. Here is a specialised kind of "permeability", an illuminating discussion of which is to be found in the section devoted to comments, conclusions and suggestions. This is followed by suggestions for future work on active ion transport, which sets out the most outstanding problems in the field awaiting solution.

Professor Krogh, who is one of the foremost authorities in this field, has incorporated a substantial portion of the experimental work, carried out by himself and his collaborators. Notes on the methods employed in the investigation of these problems, mostly developed in his laboratory, have been appended to the volume. Those interested will find these methods useful and worthy of application in similar studies.

M. S.

Simple Geological Structures. A series of Notes and Map Exercises. Second edition. By J. I. Platt and J. Challinor. (Thomas Murby & Co., London), 1940. Pp. 56 + 4. Price 2*sh.* 9*d.* net.

This is the second and slightly enlarged edition of the well-known book by Platt and Challinor, embodying a series of notes and map exercises on simple geological structures. Starting from the simplest cases of horizontal or uniformly dipping strata, the map exercises are so selected and graded as to take the student gradually through more and more complicated types of geological structure involving faulting, folding,

igneous intrusions, etc. The maps themselves have been very nicely reproduced, and the notes accompanying them are so clearly written that the student can easily follow and understand the interpretation of the underlying geological structure. To be able to 'read' a geological map is a very important part of a geologist's training, and we have no doubt that this little book by Platt and Challinor, used along with the other one by Platt on *Elementary Exercises upon Geological Maps*, will be found highly useful in giving a suitable introduction to the study of geological structures.

L. RAMA RAO

Sulphated Oils and Allied Products: Their chemistry and analysis. By Donald Burton and George F. Robertson. Foreword by Prof. T. P. Hilditch. (A. Harvey), 1939. Pp. 163 + iv. Price $5·00.

Much progress has been made and many gaps filled in our knowledge of the chemistry of the sulphation process and in the production and application of sulphated products. The need for an up-to-date book presenting all the data on this subject, hitherto greatly felt, has been filled by the publication of the volume under review.

The subject-matter has been divided into three parts beginning with a historical survey of the sulphation process and its applications with 84 references to the literature, Chapters 2 and 3 deal respectively with the chemistry of raw materials and methods of sulphation of fatty acids, esters and other derivatives of fatty acids, fatty alcohols and their derivatives, with 26 references, and the chemistry of sulphation, saturated and unsaturated acids with their glycerides, unsaturated hydroxy acids and their glycerides, unsaturated acids with an acetylene linkage, and a summary of the reactions taking place in sulphation with 25 references. The third part of the book deals with the analysis of sulphated oils, the various tests, qualitative and quantitative, with 27 references and of sulphated fatty alcohols with 34 references, and of petroleum sulphonic acids with 8 references.

Prof. T. P. Hilditch contributes an interesting Foreword to a publication which should be of the greatest value to all those connected with the textile and textile chemical industries.

J. P. DE SOUZA.

The Control of Weeds. Edited by R. O. Whyte. (Herbage Publication Series, Bull. 27. Published by the Imperial Bureau of Pastures and Forage Crops, Aberystwyth), 1940. Pp. 168. Price 7*sh.* 6*d.*

The control of weeds whether they be in farms, pastures, rivers or lakes is an international problem of high economic importance. In India, very little work has been done so far in this direction in spite of the fact that the problem, in some parts of the country, is really menacing. The reason why this subject has not so far received attention, is probably due to the circumstance that very often the remedy suggested is too expensive or research suggests the same remedies as are commonly in vogue.

But outside India, very extensive work is being carried out; there are weeds which can be eradicated by cultural, biological or chemical methods. The eradication of the prickly pear by *Cactoblastis cactorum* and of *Lantana camara* in Australia by an insect imported from Fiji are very recent and outstanding examples of biological control. Sometimes, though the remedy found is very expensive, yet the farmers have adopted it willingly for the very simple reason that the farms have been completely immunised within a period of five to six years.

The present bulletin gives a very comprehensive account of the work carried out in the world; it is regrettable that no article is contributed either from Great Britain, South Africa or India. The problem is treated by different writers from different aspects, *viz.*, the study of weeds of the farm, their root-systems and the time and depth of germination of their seeds; the weeds of the turf and their methods of eradication by nitrogenous and phosphoric manures; the application of herbicides like the compounds of arsenic and the cyanides, etc; the poisonous properties of many weeds which when eaten at certain periods (when showers of rain follow periods of drought) cause hydrocyanic acid poisoning or photosensitization in animals with unpigmented skin.

From whatever point of view the problem has been attacked, almost every contributor has shown remedial measures which if followed must result in very great economic gain. But it must be here emphasized that for the total eradication of the evil, an extensive administrative machinery is necessary. Right type of legislation has done much in America and Germany.

This bulletin will serve long as a guide for research and organization in the subject and it is hoped that at least some of the important suggestions made in it will be taken up in India. F. R. B.

Environment and Heredity. By Olive D. Maguinness. (Thomas Nelson & Sons, Ltd.), 1940. Discussion Books No. 36. Price 2*sh.* 6*d.*

This is one of the series of books called the "Discussion Books" which are designed to help intelligent citizens in discussions on modern world topics.

The book is written by a biologist who has devoted her life to teaching biology not as an academic subject but as an applied one and in her present book we see the fruits of her labour of ten years as Lecturer in Education in the University of Sheffield.

In this small book of 200 pages, the old problem which is still perplexing the biologists, is revived in a very refreshing manner. With the rapid development of the Morgan School of Genetics, biologists are too apt to forget that an organism is also a part product of its environment and not only of its genes, just as the rapid development of physiology has led many biologists to believe that life can be explained fully in terms of physico-chemical reactions.

After briefly mentioning the problems of Evolution in the introductory chapter, she discusses Mendelism and its recent developments bringing the account up to date. Then she discusses in the remaining six chapters the application of modern genetical laws to man and society and shows how difficult it is to predict the future progeny, for, each case is governed by a number of internal and external factors which we are yet unable to understand.

The book is an admirable attempt to show impartially how much Environment and Heredity play part in each individual's life. This book should be widely read by the students of biology for here, in a short space, are presented all the modern facts worth knowing. F. R. B.

Biological Notes on Indian Parasitic Chalcidoidea. By H. S. Pruthi and M. S. Mani. (Imperial Council of Agricultural Research, Bulletin No. 30), 1940. Pp. 119. Price Rs. 3.

Entomologists in India are deeply indebted to Pruthi and Mani for publishing the *Biological Notes on Indian Parasitic Chalcidoidea,* which is intended to be only a beginning, and we think it is a very good beginning. The publication is copiously illustrated and the drawings are so well executed that the artist also deserves the thanks of the reader. However, Fig. 13 shows the wings covering the major part of the insect's abdomen which, though more natural, is an unusual representation for illustrative purposes. Fig. 40 shows an Elasmus parasite with the abdomen below the coxæ, which themselves are seen sideways as flat disc-like objects, an unhappy contrast to the excellent representation of another species, Fig. 41.

In compiling the references, the authors could have exercised more critical judgment. The *Bulletin* purports to communicate biological notes and as such it was expected that the most important reference to the literature on the particular insect should have been given; if such a selection were not possible then all the references to published articles should be given. To give a concrete example, a few years ago an article was published in *Annals of Am. Ent. Soc.* on *Elasmus claripennis,* not mentioned by the Editors, but which nevertheless is the most informative reference on the biology of this insect. Incidentally it was also mentioned that there still exists another species for which the name *Elasmus Colemani* should be retained. It is nowhere mentioned that there is now in Mysore, the first parasitic laboratory in India, where an insect is called *Trichogramma minutum,* which is uncritically dispensed with the remark that Flanders considers it as only a variety of *T. evanescens. Tachardiœphagus tachardiœ* is considered specifically distinct by the discoverer of *T. somervilli* whereas Pruthi and Mani pass over the details mentioned as to the different hosts from which these two parasites can be obtained as though one was undoubtedly a variety of the other. Further they could have saved themselves the trouble of drawing Fig. 33 for, *T. tachardiœ* has been already illustrated by Imms and Chatterjee as Fig. 31 of their Memoir,—a reference not given in the bibliography.

The name of the host *Ceroplastodes cajani* as on p. 14 is wrongly named *Ceroplastes cajani* on p. 15, whereas in the Index, on p. 37, the generic name Ceroplastes stands also for insects now to be called *Ceroplastodes* sp. S. M.

INTERNATIONAL TRADE IN OILS AND FATS

International Trade in Oils and Fats. Studies of Principal Agricultural Products on the World Market, No. 4: Oils and Fats: Production and International Trade —Part I. Pp. 350, 8vo. Price 25 lire. No. 5: Oils and Fats: Production and International Trade—Part II. Pp. 430, 8vo. Price 25 lire. (International Institute of Agriculture, Rome), 1939.

A WORLD system of economics is an ideal to which even national politicians paid lip-service in 1933. After the present war has further dissipated the world's resources, it will become more than an ideal; it will become a necessity. Although at the present time it is difficult to be optimistic about the achievement of any sort of world unity, there have been examples of world-wide co-operation within limited spheres of action to offer gleams of hope. The work of the League of Nations on sociological problems has been obscured by its failure in the political sphere; the International Postal Union has been a notable example of co-operation; and most interesting of all, by reason of its potentialities as much as of its achievements, is the International Institute of Agriculture.

The inception of this Institute dates back to 1905. Although it did not develop into the organization envisaged by its rather fantastic founder, it does to a great extent provide the data, on the agricultural side, upon which attempts at a world economy must be based. Essentially it provides a continuous world census of agricultural production. The Institute publishes a monthly "International Review of Agriculture" with crop reports and estimates, reports on incidence of pests, and so on; and an "International Year-Book of Agricultural Statistics". It also deals with such subjects as farm accountancy, agricultural economics, and world agricultural legislation. Among its useful periodical bibliographical summaries the annual "Bibliography of Tropical Agriculture" has been found useful in libraries in India and Ceylon.

The work under review forms volumes 4 and 5 of a series of studies on the principal agricultural products of the world market, the first of which dealt with cotton, and the second and third with meat products.

World production of oils and fats, at least such production as finds a place in published statistics, is estimated to include ten million metric tons annually from vegetable sources, about four million tons of butter and perhaps two million tons of animal fats (including whale and other marine oils). The task of reviewing this enormous production and still more the corresponding consumption is made more difficult by the lack of adequate statistical material on these subjects, even for countries which have well-developed statistics for other products.

The present work, with its international list of contributors, probably covers the ground as well as possible. In any case the reviewer can obviously not pretend to have gone over in detail the entire contents of such a work, which almost falls into the class of Charles Lamb's *biblia abiblia*.

Treating these two volumes then as works of reference, the reviewer's first task is briefly to indicate their scope. The first section (which comprises the whole of the first volume—volume 4 of the general series of publications) treats of vegetable oils and fats; section two of the fats of land animals (including butter); and section three of oils and fats derived from marine animals.

In the fourth section the production and consumption of oils and fats in the principal importing countries are reviewed. The fifth section deals with industrial uses of oils and fats, and the tendencies of consumption in the various industries, especially margarine. A brief survey of prices concludes the work.

The statistical material is mostly complete to the end of 1936. Since then much has occurred to modify the conclusions drawn regarding tendencies of production and consumption. However one general tendency remains. Technical progress has been increasingly reducing various oils to one level of competition, the outstanding case being of course the method of hydrogenation which enabled whale and other oils increasingly to replace coconut and palm kernel oils in margarine. Some oils however still retain characteristics which enable

them to keep some of their special status. This is particularly true of drying oils such as linseed.

Apart from technical considerations, consuming trends have been considerably modified in recent years by political action in many countries, usually with the object of encouraging the production and marketing of home-produced oils and fats, as in the case of the United States processing tax in 1934. An interesting contribution by Dr. von der Decken in the work under review deals with the German Fat Plan. It is of considerable interest to compare this account with other published studies of the German measures such as Karl Brandt's "*The German Fat Plan and its Economic Setting*" (Stanford University, California, 1938) and R. Saladin's "*Les Matières grasses en Allemagne*" (Paris, 1938).

What modifications have taken place in India's trade in oils and fats up to 1936 may be studied in this volume; but it is not always easy to elicit the underlying causes or to visualise the effect of such changes. A general reduction of Indian exports probably corresponds to considerably increased internal consumption. India is now, for example, a net importer of copra (fortunately for Ceylon), whereas exports of Cochin copra and oil were considerable thirty years ago.

A statistical survey like the present work is perhaps necessarily impersonal and the student of any particular aspect of the subject will naturally supplement it with treatises of a less objective nature. Those interested in the economic significance of the fats must have a working knowledge of their sources and methods of production, their technical uses and their essential rôle in human and animal nutrition before tackl[ing] the data provided by such a work a[s] that being discussed. For this purpose th[e] reviewer cannot do better than recommen[d] the perusal of the excellent little publication of the Food Research Institute at Stanford University, California, "*The Fats an[d] Oils: a General View*" by C. L. Alsberg an[d] A. E. Taylor (1928). With this equipmen[t] the economic student would be in a muc[h] better position to fit into its proper perspective the material provided by the statistician There would follow the study of specifi[c] monographs on individual subjects. In th[e] case of the student of India, for example J. C. Bahl's "*The Oilseed Trade of India*" (Bombay, 1938) would provide useful late[r] reading.

Behind compiled statistics of productio[n] and consumption there stand the individua[l] producer and consumer, and it is a usefu[l] exercise in imagination to attempt the translation of a statistical table into human terms It is one thing to read that castor seed fro[m] Brazil has replaced that from India by s[o] many thousand tons; it is another to envisage what this has meant to cultivator in Hyderabad. Technical advances such a[s] hydrogenation which have added large resources of new material to the world's suppl[y] of edible fats, may be regarded as advantageous increases of man's control over natur[e] The Ceylon coconut small-holder may b[e] pardoned if he is unappreciative.

This review may thus end where it bega[n] by regarding its subject, or rather the organization responsible for the present study o[f] its subject, as a small hopeful pointer towards a better organization of world economy by means of which scientific progres[s] may contribute to the well-being of all.

R. CHILD.

THE TENTH INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY

THE Congress was opened on May 7th, 1939 in the city of Washington D.C., and later held in the New York City, where it terminated on May 19th, 1939. More than thirty nations were represented at the Congress. Col. A. C. Munro, of the Indian Medical Service, was one of the delegates to the Congress.

In his address, the President of the Congress complimented the delegates from thirty-two distant countries, who had come there to lay the resources of medicine before the people of all nations, who are or who may be exposed to the greatest enemy, *viz.*, war. Medicine has no social, national or military boundaries and it has no military enemies. The President briefly referred to the triumphs of military medicine and surgery during the last War and the many problems, which still remained unsolved. He said, "In spite of the inhumanity of war, which is the most debased act of civilised man, some of the by-products of war have been beneficial. A war gives the first notice to the nation of the physical unfitness of a large proportion of its youth, much of it due to remediable defects. It serves as a warning to the nation to take an account of its state of health". He continued, "Medicine is not war-minded. Rather it ministers to the peace of mind, body and soul; if in the course of events the forces of mass brutality prevail over the gentle mandates of the prince of peace, medicine shall be ready to rescue from the wreckage of human folly."

A symposium was held under the joint auspices of the *Association of Military Surgeons* of the United States and the *Tenth International Congress of Military Medicine and Pharmacy*. The subject of the symposium was "The rôle of aviation medicine in the development of aviation". The report of this symposium is the most informative reading in the Proceedings. In it, we find a historical sketch of all the interesting researches made on the medical aspects of aviation—the symptoms produced at high altitudes, the adaptability of the physiological functions of the body to high altitudes, the attempts made to overcome the ill-effects of altitude and other important questions relating to aviation medicine.

Modern aviation is only slightly over thirty-six years old. While much work has been carried out on the mechanics of aviation, it is only recently that attention is being given to the pilot. In most of the progressive countries, minimum standards for military pilots have been drawn up and also a special medical service for aviators has been established. All the principal countries engaged in the Great War had medical departments which were integral parts of their air services. Post-War aviation medicine progressed with the development of civil airways, including passenger air transportation and air mail service. Thanks to the progress of aeronautics and the proper selection of pilots, air transportation to-day is as comfortable as that of land travel. The establishment of civil aviation created the need for civil flight surgeons. Aviation medicine is now an important and well established branch of general medicine. Owing to the phenomenal growth of air transport and the rapidly expanding military air force, Aviation Medicine is bound to occupy a prominent place as a special subject in medicine.

The various subjects discussed at the symposium were:—(1) The organisation and function of the medical services in colonial expeditions, (2) Probable casualties in war and methods of calculation, (3) Practical procedures for anæsthesia and analgesia in war surgery, (4) Organisation and function of the Military Chemico-Pharmaceutical service, (5) Emergency treatment and primary apparatus for fractures of the jaws in the war, (6) Technical specialisation of administrative officers in the medical service, and (7) Oxygen therapy and its practical use with troops on active duty.

On the tenth day of the session, held at New York City, several interesting papers, *e.g.*, "World War experiences in Turkey," "Surgical practice in Panama," "Surgical anæsthesia," "The influenza epedimic," "International agreements relating to hospital ships," "Biopsy of the lung with broncho-catheter," were read and discussed.

The delegates were treated to lavish banquets, and taken round to various places of interest, including the New York World's Fair.

All the delegates carried away with them splendid recollections of American hospitality. Col. Thomann submitted the formal invitation of his government to hold the next International Congress in Switzerland in 1941. The acceptance of the invitation by the International Committee was unanimously approved by the Congress, which expressed its thanks to the Swiss Government through its representative, Col. Thomann. Capt. Bambridge was presented with a medal in appreciation of his work in connection with the International Congress, since its foundation in 1921.

T. S. TIRUMURTI.

CENTENARIES

Stark, William (1740-1770)

WILLIAM STARK, a British physician, was born in Birmingham July, 1740. Having become an M.A. (Philosophy) of the Glasgow University in 1758 and after spending seven years at Edinburgh, he came to London in 1765 and devoted himself to the study of medicine at St. George's Hospital.

Dietetical Experiments

Under the guidance of John Hunter he took up the experimental study of blood and other animal fluids. He graduated M.D. at Leyden in 1766. In June 1769 he began a series of experiments on diet. The zeal with which he tried the experiments on his own body ruined his health.

To ascertain the effects of different quantities and kinds of food upon the human economy, Stark confined himself for periods of from four to fourteen days to certain articles of diet and carefully registered the influence which they seemed to exercise on the several functions of the body. He began for instance with bread and water; then he added to them, in succeeding periods, sugar, olive oil and milk; then he took different kinds of animal food and each in different quantities. Then he experienced with a diet of bread, honey and tea. In fourteen days this brought on diarrhoea. To remedy this he changed over to bread, cheese and rosemary. This produced a totally opposite state of the intestines with inflammation of their glands.

His *Works consisting of clinical and anatomical observations, with experiments diatetical and statical* were published in 1788.

Victim to Science

Stark's persistent pursuit of the dietetic experiments on himself made him a victim to his enthusiasm within seven months, 23 February 1770.

Ball, Robert Stawell (1840-1913)

ROBERT STAWELL BALL, an Irish astronomer, was born at Dublin 1 July 1840. He had a brilliant career at school and at Trinity College, Dublin, where he carried away many prizes, medals and scholarships. While tutor to the sons of the Earl of Rosse between 1865 and 1867, Ball had the opportunity to use the celebrated six-foot reflecting telescope of Lord Rosse. Through it he made regular observations of nebulæ and developed his interest in practical astronomy.

His Career

Ball was successively professor of applied mathematics in the Royal College of Science at Dublin (1868–1874); Andrews professor of astronomy in the University of Dublin and royal astronomer of Ireland (1874–1892); and Lowndean professor of astronomy at Cambridge. Due to the loss of his right eye, he had to give up observational work. But his reputation as a professor knew no bounds.

His Publications

In 1888 he published the well-known and much-used *Treatise on spherical astronomy*. Between 1877 and 1906 he published no less than thirteen popular books on astronomy. As a popular lecturer he came in contact with the widest circle. He delivered courses of Christmas lectures at the Royal Institution and for many years he lectured under the auspices of the Gilchrist Trust. His lecturing services were also requisitioned in America on three occasions.

As a Mathematician

While Ball was best known to his contemporaries through his popular lectures, he will be best remembered by posterity for his researches in Mathematics. As a true product of the Dublin school, his flair was along geometrical lines and all his researches were unified by his theory of screw motions. The ideas developed in twelve memoirs published at different times by the Royal Irish Academy, were later incorporated in two well-known treatises of permanent value: *Theory of Screws: a study in the dynamics of a rigid body* (1876) and *Treatise on the theory of screws* (1900). Even after these treatises were published, he further extended the subjects right up to his seventieth year through four more memoirs. These contributions have led Prof. E. T. Whittaker to rank him as "one of the two or three greatest British mathematicians of his generation".

Ball was knighted in 1886 and died at Cambridge 25 November, 1913.

S. R. Ranganathan.

University Library,
Madras.

SCIENCE NOTES AND NEWS

A Preliminary Study on Orange Fruit Rot.—Oranges from Kalimpong placed on sterilised glass plates and covered by large bell-jars, were observed to develop rot. Isolations of the fungus were made by planting bits of diseased rind in tubes of potato-dextrose agar, Czapeck synthetic agar medium and Coon's medium. The pathogenicity of isolates was tested by inoculation of healthy orange fruits.

The following is the list of species of fungi thus isolated in pure culture: (1) *Penicillium expansum* Link. (2) *Penicillium italicum* Whemer. (3) *Penicillium digitatum* Sacc. (4) *Aspergillus niger* Van Tiegh. (5) *Cladosporium herbarum* var. *citricolum* F. & B. (6) *Trichoderma lingorum* (Tode) Harz. (7) *Colletotrichum gloeosporioides* Penz. (8) *Alternaria citri* Pierce. (9) *Botrytis cinerea* Pers. (10) *Fusarium moniliforme* Sheldon.

T. C. Roy.

Rôle of Coenzymes in Dehydrogenase Systems.—In the cozymase-dependent dehydrogenase systems, the coenzyme functions essentially as a reversible hydrogen acceptor. Thus in the alcohol dehydrogenase system, the chain of reactions leading to the oxidation of alcohol may be pictured thus: The substrate (alcohol) combines with a specific group in the dehydrogenase to form a dissociated compound; similarly, the cozymase also forms a dissociated compound with the dehydrogenase; two atoms of hydrogen pass from the alcohol to the cozymase; the latter reacts with the flavoprotein and gets reduced; fresh units of alcohol and cozymase combine with the dehydrogenase and the process goes on. The reaction is reversible, so that the group in the dehydrogenase protein which combines with the alcohol also combines with the aldehyde and the same is true of the oxidised and reduced cozymase.

Two views have been advanced to interpret these facts: according to the first, the relation of the dehydrogenase to coenzyme is that of an enzyme to its substrate; the reaction does not differ fundamentally from the other bimolecular reactions catalysed by enzymes. According to the other view, cozymase is the prosthetic group of the dehydrogenase protein and it is this "Pyridine-protein" complex that functions as the active enzyme. According to this view cozymase is regarded neither as a substrate nor as a coenzyme in the strict sense of these terms. This view offers a unified conception of the oxidising enzymes, catalase and peroxidase and more particularly the diaphorase and amine oxidase.

The recent work of Dixon and Zerfas (*Biochem. J.*, 1940, 34, 371) is of particular importance in understanding the rôle of cozymase in the dehydrogenase systems. These workers have made an extensive study of 2 typical dehydrogenase systems employing a wide range of H-acceptors. For the first view to be tenable, H-acceptors should be available which are directly reduced by the oxidised substrate without the intervention of cozymase. If the second view is correct, no matter what acceptor is employed, under no condition is it reduced unless cozymase is also present. Dixon and Zerfas tested the ability of the alcohol and malic dehydrogenases of yeast—2 typical dehydrogenases which are known to act through cozymase and of which coenzyme-free preparations can be prepared—, to reduce a variety of H-acceptors—dyes, quinone, alloxan, iodine, hydrogen peroxide and aromatic nitro compounds, with and without cozymase. As a result of this study, they showed that acceptors, alloxan, iodine, hydrogen peroxide and dibromophenolindophenol are capable of being reduced by activated substrates in the *absence* of cozymase or flavoprotein. This leads to the important conclusion that the relationship between the dehydrogenase and cozymase is that of an enzyme to its substrate and not that of a "protein" to its prosthetic group. There are a number of arguments against the acceptance of the view that cozymase functions as the prosthetic group of the dehydrogenase. It should be made clear, however, that the substances which function *like* cozymase as direct H-acceptors do not equal cozymase in efficiency.

P. R. V.

Breeding of the Stork.—It is well known that the nest-building habit amongst birds is extremely fascinating because of the variety it exhibits. The bigger birds must naturally build a strong nest for the parent bird to sit and incubate. In the painted Stork *Ibis*, Weinman records [*Ceylon J. Sci.*, 1940, 22 (B)] that a pair succeeded in building a rough and untidy nest with a lining of feathers in a week's time. Three eggs were laid and were incubated by the female in the morning and during nights the male took charge. Eggs were rolled from time to time by the beaks and the nestlings appeared after a lapse of 28 days. Unfortunately, when the parent birds left for foraging food, the predacious crows made short shrift of the nestling. A new family was raised by the same pair almost a few days after the bereavement. The young bird was fed by the parents for nearly three months and when it commenced to take aerial reconnoitres, it stood nearly 18 inches in height. It is remarkable that in these Ibises which generally breed in colonies in mangrove and other trees, the powerful instinct of breeding manifests and is successfully carried out even under domestication.

The Morphology of the Human Sperm and Egg.—Gatenby and Aykroyd's paper (*Proc. Roy. Irish Acad.*, 46, Sec. B, 39) is devoted to a critical discussion of a recent work by Popa and Marza on the structure of the human sperm. On account of its minuteness as well as on account of the different methods that have been employed to study it, the human sperm still

remains an object of conflicting interpretations and the present authors attempt to say the last word on it. According to them the human sperm examined after proper treatment consists of ten parts,—acrosome, nucleus, post-nuclear cup, neck granule, neck, proximal centriole, middle piece, distal centriole, tail and flagellum. Many of the structures reported by Popa and Marza, like the middle piece bead and the sensillæ amœboidæ, are believed to be nothing other than artefacts and are not true parts of the human sperm.

The human egg is interesting in regard to the distribution of the cytoplasmic elements. The golgi bodies and the mitochondria occupy two distinct zones in the cytoplasm,—the former, peripheral, and the latter, central. There is no neutral fat, nor is there any yolk in it.

Mango Budding.—As may be well known, the most successful and commonly practised method of propagating the mango vegetatively is by means of grafting and not by means of budding as in the case of most other fruit or flower plants. The grafting too is a variation of approach grafting which goes by the name of inarching. As the result of much experimental work Burns and Prayag concluded that in the mango, budding was an uncertain means of propagation and that in India, it therefore could not be recommended. Recent work, however, carried out in Sind shows that budding can be very successfully effected in the mango, just indeed as effectively as in the case of other plants. Success in budding the mango on the Government Fruit Farm, Mirpurkhas, Sind, now scores at 60 per cent. and during the years 1937, 1938 and 1939 over 700 budded plants were also distributed to the public (Ali Mahomed Ulvi, *Indian Farming*, May 1940). Full details of the technique of the process are given in the article including nursery raising, suitable season for budding, selection and treatment and insertion of the bud, etc.,—all applicable of course to Sind conditions. There is nothing special or complicate in the technique, climatic and other local conditions being apparently responsible for this welcome success. It may be a useful line of work in the South Indian and other Fruit Stations to repeat the work under their conditions, now that the success of the process has been demonstrated, albeit in a different part of India.

A. K. Y.

Ten years of research on the influence of manures on the quality of crops, at the *Imperial Agricultural Research Institute*, has led to the important conclusion that manures and fertilisers are capable of influencing the composition and quality of the crop to such an extent as to appreciably affect its value as seed and as food. This finding is of great importance both from the scientific and practical points of view. The need for research on a rational system of manuring the soils and crops to the best advantage becomes clear. In a country like India, where a great majority of soils are poor in organic matter and where in many cases, one variety of grains form the bulk of the diet of the major part of the population, this work carried out at the Institute is of special importance.

Monograph on the Ox.—The Advisory Board of the *Imperial Council of Agricultural Research* at its 21st meeting held in Simla on June 27–29 has approved of the grant of funds for the preparation of a critical monograph on the Anatomy of the Ox. No text-book, devoted specially to the anatomy of the ox, has ever been produced anywhere and it is considered that such a text-book is desirable in view of the importance of the ox in India.

The Central Committee of the **Tuberculosis Association of India** has released to the public, the scheme for "the control of tuberculosis by organised home treatment". The principle behind the tuberculosis campaign in India must be to search out "the tuberculous patients in order to fight the disease wherever it exists and is spreading, and it needs the following five main activities for a successful working:—(1) the tuberculosis clinic, (2) institutional treatment for a certain number of selected patients, (3) close co-operation between the clinic and the private practitioners, (4) care and after-care committees to work in connection with the clinics and other tuberculosis institutions, and (5) colonies or settlements for tuberculosis ex-patients. Copies of the pamphlets can be obtained from the Secretary, *Tuberculosis Association of India*, 20, Talkatora Road, New Delhi, free of charge, on request.

The Health Organisation of the League of Nations is considering the constitution of an **International Documentation Centre for Health Matters.** According to the latest issue of the *Chronicle of the Health Organisation* "the Service of Epidemiological Intelligence and Public Health Statistics has, in the past, frequently had to reply to requests for documentary material received in the most varied forms from the public authorities of various countries, and relating usually to the health conditions of some particular region, to the course of prevailing epidemics or to recent demographic data. For some time past, such requests for information have shown a tendency to increase, and even to overstep the limits of the Health Organisation's work. During the first six weeks of 1940, 21 requests of this kind were answered. They came from governments, public health departments, specialists and professors of faculties of medicine, and from various bodies.

"The result, as can well be realised, has been an increase of work; but it is of undoubted utility. The decision has accordingly been taken gradually to build up a documentation centre, the organisation and control of which have been entrusted to Dr. Biraud. In the present circumstances, obviously, all that can be done is to prepare for the future, by making arrangements for the classification and utilisation of the documentary material in the hands of the Health Organisation. The service is thus one which is still in embryonic form, but should

normally be capable of development when circumstances permit."

Indian Eugenics Society.—An Indian Eugenics Society has been formed with its office at Calcutta. The Society aims at furthering the principles of human genetics and racial hygiene and their practical applications for the betterment of the Indian population with a view to enhance its surviving capacity in the struggle for existence. The Society seeks to promote scientific research in the fields of Racial and Social Biology, to spread the knowledge of racial biology and hygiene as well as the practical rules of conduct following therefrom among the people. The Society will work in co-operation with other scientific bodies working in the field of Eugenics, like the International Human Heredity Committee, London, the International Commission of Eugenics, America, etc.

The Society proposes to publish bulletins from time to time and arrange for popular lectures in different centres. The Society will also carry out investigations of medico-legal and criminological nature on behalf of recognised bodies or *bonafide* individuals.

A booklet entitled "A Plea for Eugenic Researches in Bengal" discussing the various eugenic problems of the country will shortly be published by the Society.

Dr. B. K. Chatterji, D.SC. (Paris), is the President of the Society. The office of the Society is at present located at 60/1 B, Chakraberia Road North, Calcutta.

The General Secretary will be glad to give all necessary information to the interested public.

Sugar Industry in India (1938-39).*—During the year 1938–39, the output of sugar and gur in India was considerably lessened over the previous year's output. Only 139 factories out of 158 existing in India, worked directly with cane and produced 650,800 tons of white sugar as against 930,000 tons of the previous year, showing a decline of 30 per cent. Inclusive of sugar from gur refining, and khandasari sugar industry the total sugar production was 766,000 tons which is about 3 lakhs of tons below the normal consumption requirements of the country. Again, the net production of gur was 2,728,000 tons as against 3,364,000 tons of the preceding season. This remarkable short production of both white sugar and gur is due mainly to scarcity of cane supply as a result of reductions in the acreage under cane and extensive damage to crop in the U.P. and Bihar. The cane was also of poor quality in parts of the U.P. and Bihar owing to diseases and floods.

A similar decline in molasses trade was also noticed. The total production of molasses in India during 1938–39 was 350,000 tons as against 484,000 tons during the corresponding previous year. Of this, 242,300 tons were produced in central sugar factories while the figure for the previous season was 349,600 tons. The imports of molasses by sea into India in 1938–39 was 2,160 tons as against only 5 tons in the previous season.

During the period under review the output of cane in India fell by over 22 per cent. from 55,600,000 tons in 1937–38 to 43,100,000 tons.

The Sugar Industry (Protection) Act of 1932 had directed instituting a further enquiry on the sugar industry regarding the rate of protection for the period 1–4–38 to 31–3–1946. Accordingly, the question was referred to the Tariff Board which submitted its report in December 1937. The recommendation of the Board for the continuance of the existing rate of protection (namely Rs. 7–4–0 per cwt.) till March 1946 was not accepted by the Government who however decided on the reduced rate of protection of Rs. 6–12–0 per cwt. until April 1941, and the measure of protection for later periods was to be fixed after a further enquiry. The excise duty on Khandasari sugar was reduced from Re. 1 to As. 8 per cwt. withdrawing simultaneously the exemption from this duty enjoyed hitherto by concerns employing less than 20 persons.

The yield of revenue from excise duty on sugar in 1938–39 was Rs. 4,22,44,491 on white sugar and Rs. 58,607 on Khandasari sugar, against Rs. 3,30,96,902 and Rs. 50,427 respectively in 1937–38.

Owing to the short production in 1938–39 the sugar prices moved up and made possible the imports of sugar from Java to fill the gaps in home production. The quantity of sugar thus imported was 24,510 tons as against 10,293 tons of last year.

The consumption of sugar in India in the crop year 1938–39 has been estimated at 1,083,000 tons as against 1,159,000 tons in 1937–38 and 1,167,000 tons in 1936–37.

The rising level of sugar prices enabled the governments of U.P. and Bihar to fix minimum prices for cane and these prices were substantially increased during the season to keep pace with the rise in sugar prices. The higher prices thus given for cane diverted large quantities of cane to sugar factories from gur industry with the result that the production of sugar in the season 1939–40 is likely to be much larger than was estimated at the beginning of the season and this is expected to bring down the sugar prices.

G. G. RAO.

Money and Banking 1939/40.—The latest Monetary Review more usually referred to as "a veritable blue-book of international finance" issued by the *League of Nations* (Ser. L.o.N.P., 1940, II, A 2/I, pp. 104, Price 3*sh.*) is of particular interest and will be indispensable to everyone wishing to keep abreast of the far-reaching changes brought about by war in the world's monetary mechanism. According to a note issued by the Information Section of the League, the *Review* describes "the various Government measures adopted since September 1939 to control the exchanges and to mobilise foreign assets, to deal with the abnormal demand for liquidity in general and for notes and coins in particular, and to meet the exceptional

* From a 'Review' by R. C. Srivastava, in a Supplement to the *Indian Trade Journal*, May 30th, 1940.

loan requirements of the State; and it examines the influence of these various factors on the monetary supply and on the cost of credit.

"The first chapter presents, more especially, a survey of recent movements in exchange rates and a comprehensive analysis of the war-time restrictions on foreign payments and capital transfers. The second is mainly concerned with the war-time liquidity problem and with the measures taken, according to circumstances, to check or to satisfy the demand for liquid resources and means of payment. Stock Exchange and banking regulations are discussed in this connection, as well as moratoria and special credit facilities, issues of new kinds of currency, and changes in central bank legislation designed to remove the traditional limitations on the note issue.

"There follows a chapter on war finance and the money market, describing the methods of Government borrowing in a large number of countries, and calling special attention to the part played by central and commercial banks in Government financing. The fourth chapter deals with the resulting expansion in the volume of currency and credit, and points out significant movements in discount rates, bond yields and share prices. Recent currency measures in Czecho-Slovakia, Danzig and Poland are summarised in a supplementary note."

The Breeding of Herbage Plants in Scandinavia and Finland.—Arrangements have been made between the various Imperial Agricultural Bureaux whereby any publication upon the preparation of which two or more Bureaux collaborate shall be included in a new series entitled Joint Publications. It has been decided to regard the earlier Joint Publications on "Vernalization and phasic development of plants" and "Erosion and soil conservation", as Nos. 1 and 2 in this series. Other Joint Publications produced in recent years but already out of print have not been given numbers in the series.

The *Imperial Bureau of Plant Breeding and Genetics* and the Imperial Bureau of Pastures and Forage Crops have now produced Joint Publication No. 3, entitled "The breeding of herbage plants in Scandinavia and Finland". It is a symposium consisting of a series of articles by acknowledged specialists in the respective countries. G. Nilsson-Leissner, F. Nilsson, E. Åkerberg and R. Torssell contribute articles on work in Sweden, H. N. Frandsen, H. Wexelsen and O. Pohjakallio on Denmark, Norway and Finland respectively. Each article reviews recent developments in the countries concerned, including details of the most recent improved strains of grasses, clovers and lucerne, and the methods used in producing them, as well as a contribution on the application of cytology to herbage plant breeding. The articles vary from 5 to 35 pages in length and are mostly quite detailed, each being provided with a mass of tabular data and selected bibliographies. The Scandinavian countries are recognized authorities on grassland and breeding problems and the bulletin provides an invaluable outline of achievements up to date. This is made specially clear by a useful summary of the entire contents of the bulletin which appears at the beginning, before the presentation of the individual articles. Another useful feature is the provision of a list of addresses of the research stations concerned and of maps illustrating their locality.

The bulletin covers some 125 pages and is obtainable from either Bureau at the moderate price of 4*s*. Standing orders for Joint Publications should be placed with the *Secretary, Imperial Agricultural Bureau, 2 Queen Anne's Gate Buildings, London, S.W. 1.*

In his recent Presidential Address to the **Mining, Geological and Metallurgical Institute of India**, Mr. J. B. Ross, M.L.C., deals with the economic problem of the coal trade as it exists to-day, viewed from the administrative point of view. After giving several facts and figures relating to the present conditions of the coal industry in India, he urges the need for a Central Committee elected by and representing the different associations interested in the coal trade. The appointment of such a Committee represents in his view, "a step in the right direction towards co-operative thinking and action of which the trade stands so badly in need, and which the present diversity of interests makes so difficult of attainment."

The Annual Report presented to the General Body by the Hon. Secretary gives an account of the various activities of the Institute during the year. On the recommendation of the Judging Committee the following Prizes and Medals were awarded: (*a*) The Government of India Prize of Rs. 500 to Mr. B. Wilson Haigh for his paper entitled "Coal Carbonisation and Some of its By-products"; one Institute Silver Medal to Dr. F. G. Percival and Dr. E. Spencer for their joint paper on "Conglomerates and Lavas in the Singhbhum—Orissa Iron Ore Series"; one Institute Silver Medal to Dr. M. S. Krishnan for his paper on "Mineral Wool"; one Institute Bronze Medal to Dr. D. Swarup, Mr. V. G. Iyer, and Mr. A. H. K. Iyer, for their joint paper on "An Investigation into the Possibilities of Manufacturing Carbon Electrodes in India"; and one Institute Bronze Medal to Mr. L. J. Baraclough for his joint paper with Mr. S. B. Hall on "Hydraulic Stowing in India: Obtaining Supplies of Sand."

Indian Chemical Manufacturers Association.—The first Annual Report of the activities of the Association is an interesting and thought-provoking volume. The Association has about 25 important manufacturing firms from all parts of India on its membership roll and has been doing a lot of useful work during the short period of its existence. The chemical industry in India is suffering from a number of difficulties and one of the objects with which the Association was started, was to draw the pointed attention of the government to these difficulties and suggest means of overcoming them. The Association has been tackling such important questions as the varying rates of excise duty

in the various provinces (leading to difficulties in movement of goods), high railway freight on chemical and allied products, high import duties on raw materials for the chemical industry, the urgent need for introducing a comprehensive act to control the drug industry and the desirability of curtailing the activities of the Government Medical Stores Departments. The Association has been corresponding with the Government of India, the Provincial Governments, the Railway Authorities, etc., on these matters. Most of the problems which have been dealt with by the Association are connected with the pharmaceutical industry which is perhaps the best established branch in India of the chemical industry. It is true that most of these grievances are still to be redressed; but this is due to the indifference and apathy of the authorities and the Association deserves all credit for the fight it has put up on behalf of the industry. The Association has given valuable advice to the Government of India regarding the new Drug Act which was passed recently. It has also taken up the question of scarcity of raw materials required for pharmaceutical and other chemical industries which has resulted after the outbreak of war. The members of the Association were requested to give lists of raw materials they require and the possibility of manufacturing some of these was also discussed. The Association has many other useful activities to its credit and is fulfilling a most important function. If its membership increases as it is bound to do, it will help the chemical industry in India to present a united front.

C. V.

The Annual Report of the **Mysore Civil Veterinary Department** for the year 1938–39, which has just been issued, is a valuable record of the very useful work undertaken by the Department in connection with the improvement of live-stock and the prevention and spread of contagious diseases of animals. There were stray outbreaks of rinderpest disease all over the State; systematic inoculation campaigns were carried out and the disease was brought under control. The Veterinary Research Officer, Dr. P. M. N. Naidu, carried out investigations on the etiology of many diseases prevalent in the State. The new Saponin vaccine for the treatment of anthrax, prepared by him, was experimented in several places with very encouraging results. Some 839 animals including sheep, goats, lambs and kids were protected by the vaccine. At the request of the Chief Commandant, Mysore State Troops, investigations into the cause of sterility and frequent abortions among the stud mares at the Kunigal and Hessaraghatta Farms were undertaken. The scheme of investigation into the Johne's disease financed by the Imperial Council of Agricultural Research was extended for a further period of two years.

The Madras University has awarded the Degree of Doctor of Science to Mr. A. Narasinga Rao, M.A., L.T., Professor of Mathematics, Annamalai University.

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ASTRONOMICAL NOTES

Planets during August 1940.—Venus continues to be a very bright object visible in the eastern sky for over three hours before sunrise. On August 2, the planet will be at its greatest brilliancy, the corresponding stellar magnitude being $-4 \cdot 2$. Mercury is in the morning sky, and on August 10 reaches greatest elongation west of the Sun (18° 57′) when it will be rising about an hour before sunrise. Mars continues to approach the Sun in the evening sky and after reaching conjunction with the Sun on August 30, passes into the morning sky.

Both Jupiter and Saturn will be near the meridian at sunrise and are well placed for observation during the latter part of the night. The two planets will be in conjunction with each other on August 15, when the angular distance will be only about a degree and a quarter. Saturn will reach one of the stationary points of its geocentric orbit on August 27, and will begin to move in a retrograde direction among the stars. Uranus is slowly moving eastwards in the constellation Taurus and can be seen as a sixth magnitude star about five degrees south of the open cluster Pleiades. It will be in quadrature with the Sun on August 19.

The Perseids: One of the most important meteoric showers is the Perseids which occur regularly every year in August, the date of maximum display being about August 12. The radiant point is situated in R.A. 47°, Declination 57° North, about 7° to the north of the second magnitude star α Persei. T. P. B.

Lady Tata Memorial Trust.—The award of the following scholarships for the year 1940–41 has been announced: (1) Mr. K. Ganapathi, B.A., M.SC. (Synthesis of compounds of sulphanilamide group), (2) Mr. T. J. Job, B.A., M.SC. (The practical utility of insectivorous fishes in the biological control of mosquitoes), (3) Mr. Manmatha Kumar Haldar, M.SC. (Anemia with special reference to the hæmopoietic factors and the availability of iron from different sources of hæmoglobin formation), (4) Dr. Saschchidananda Bannerji, M.SC., M.B. (The comparative methods for determining the Vitamin C status of the body and the rôle of Vitamin C in infection) and (5) G. B. Ramasarma, B.SC. (HONS.), A.I.I.SC. (Investigations on Vitamin A, specially provitamins and the rôle of fat in their absorption).

MAGNETIC NOTES

The magnetic activity during June 1940 was on the whole similar to that during the previous month. There were 9 *quiet* days, 19 days of *slight* disturbance, one day of *moderate* disturbance and one of *great* disturbance as against 6 quiet days, 23 days of slight disturbance and one day of great disturbance during June 1939.

The day of largest disturbance was the 25th when a magnetic storm of great intensity was recorded. The quietest day was the 1st. The characterisation of individual days is shown below.

Quiet days	Disturbed days		
	Slight	Moderate	Great
1, 10-13, 20, 21, 27, 30	2-9, 15-19, 22-24, 26 28, 29	14	25

During the month there was only one storm and that of great intensity as against one storm also of great intensity recorded during June of last year. The mean character figure for the month is 0·77 while that for June 1939 was 0·83.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of June 1940, one slight and one moderate earthquake shocks were recorded by the Colaba seismographs as against one slight and three moderate ones recorded during the same month in 1939. Details for June 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)
		H.	M.	(Miles)	
June 5	Slight	16	31	6290	
,, 22	Moderate	17	07	3390	Near 1°·5 N., 120°·0 E., in Celebes Sea

ANNOUNCEMENTS

The Second Session of the *Tuberculosis Workers' Conference* will be held in November 1940 in New Delhi. The exact date of the Conference and the programme therefor, will be announced in due course.

The fourth Special Tuberculosis Number of the *Indian Medical Gazette* will be issued in October 1940. Some of the distinguished tuberculosis workers in the country have agreed to contribute papers on clinical and preventive aspects of the problem.

The attention of our readers is drawn to the advertisement appearing elsewhere in this number calling applications from duly qualified candidates for the post of Director of Fisheries, Ceylon. The post carries a salary of Rs. 10,800 per annum rising by annual increments of Rs. 600 to Rs. 14,400. Last date of application August 20, 1940.

We acknowledge with thanks the receipt of the following:—

"Journal of the Annamalai University," Vol. 9, No. 3.

"Agricultural Gazette of New South Wales," Vol. 51, Pt. 6.

"Journal of the Royal Society of Arts," Vol. 88, Nos. 4560–61.

"Allahabad Farmer," Vol. 14, No. 4.

"Biochemical Journal," Vol. 34, No. 4.

"Journal of the Institute of Brewing," Vol. 44, No. 5.

"Journal of the Indian Botanical Society," Vol. 18, Nos. 4–6.

"Contributions from Boyce Thompson Institute," Vol. 11, No. 2.

"Journal of Chemical Physics," Vol. 8, No. 5.

"Russian Journal of Chemistry," Vol. 10, Nos. 1–2.

"Experiment Station Record," Vol. 82, No. 4.

"Indian Forester," Vol. 66, No. 7.

"Transactions of the Faraday Society," Vol. 34, No. 229.

"Genetics," Vol. 25, No. 3.

"Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 11, No. 3.

"Bulletin of the Indian Central Jute Committee," Vol. 3, No. 3.

"Proceedings of the Royal Irish Academy," Vol. 45, B. 17; Vol. 46, B. 1–3.

"Bulletin of Health Organisation (League of Nations)," Vol. 9, No. 1.

"Chronicle of Health Organisation (League of Nations)," Vol. 2. No. 4.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 36, Pt. 1.

"Review of Applied Mycology," Vol. 19, Pt. 5.

"Journal of the Indian Mathematical Society," Vol. 4, No. 2.

"Indian Medical Gazette," Vol. 75, No. 6.

"Acta Physicochimica," Vol. 12, No. 1.

"National Academy of Sciences, Proceedings," Vol. 9, Pts. 2 and 3.

"Journal of Nutrition," Vol. 19, No. 5.

"Nature," Vol. 145, Nos. 3679–82.

"Canadian Journal of Research," Vol. 18, No. 5, A, B, C, D.

"Ceylon Journal of Science," Vol. 22, Pt. 1.

"Sky," Vol. 4, No. 7.

"Indian Trade Journal," Vol. 137, Nos. 1773–75 and Vol. 138, No. 1776.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences (*Proceedings*):

June 1940. SECTION A.—SIR C. V. RAMAN AND V. S. RAJAGOPALAN: *Colour of Stratified Media—I. Ancient Decomposed Glass.* Brewster's explanation of the iridescence as due to films of air separating thin layers of glass is definitely erroneous. The material is optically and mechanically continuous, but has an open framework structure which is quasi-periodic or stratified. Nine microphotographs and twelve spectrograms illustrate the paper. SIKHIBHUSHAN DUTT: *Colour in Relation to Chemical Constitution of the Phthalein Dyes. Phthaleins of the Mixed Type.* The colour phenomena exhibited by the unsymmetrical and symmetrical phthaleins on treatment with alkali are quite comparable with similar phenomena exhibited by iso-nitroso-1:3-diphenyl-thiohydantoin and iso-nitroso-1:3-diphenyl-thiobarbituric acid under identical conditions as studied by Dutt and his pupils, and due to the same cause. A. NARASINGA RAO: *Studies in Turbine Geometry—IV. The Topology of Oriented and Non-oriented Line Elements in the Inversive Plane.* B. RAMAMURTI: *A Geometrical Proof of a Theorem of Spinors.* K. SAMBASIVA RAO: *Generalisation of a Theorem of Pillai-Selberg.* T. R. SESHADRI AND J. VEERARAGHAVIAH: *Chemical Investigation of Indian Fruits—Part I. Bitter Principles of Pamparapanas (Indian Shaddock).* The peels and rags contain 0·13% and 1% respectively of naringin. The seeds contain 0·15% naringin and about 0·6% of limonin and some isolimonin. N. W. HIRWE, K. D. GAVANKAR AND B. V. PATIL: *Studies in Chloralamides—Part II. Chloral Nitro- and Chloral Bromo-Salicylamides.*

June 1940. SECTION B.—I. FROILANO DE MELLO: *Experimental studies on diets deficient in Vitamin B and their influence on the intestinal yeast flora of animals.* Yeast infestation of the intestines of animals should be considered as a case of normal commensalism. The variations in the degrees of such an infestation may, however, be taken as an analytic test for deficiency arising from beriberigenic diets. There is a large increase in the number of yeasts when the animals are placed on beriberigenic diets, and the number generally decreases to the normal health level when the animals suffering from experimental avitaminosis are fed on normal diet. B. N. SINGH AND M. P. SINGH: *Diurnal march of carbohydrates in relation to biochemic constitution of leaves.* S. L. VENKITESWARAN AND M. SREENIVASAYA: *On Tyrosinase of* Dolichos lablab—*I. Methods of estimation and the oxidation of different substrates.* The general substrate specificity of the enzyme suggests that it is not a "laccase", since the enzyme preparations have been found to be inert towards *p*-dihydroxy compounds. C. SRIKANTIA, C. KRISHNASWAMI RAO AND T. PRASANNASIMHA ROW: *Glutathion in anæmias. Its variations in the blood and its relation to the erythrocyte count and hæmoglobin content.* There is a marked increase in the corpuscular glutathion in anæmias generally and in ankylostome anæmias the increase is higher. SHRI RANJAN AND V. R. JHA: *The effect of ethylene and sulphur dioxide on the fruits of* Mangifera indica. The physiology of the black tip disease of mangoes has been studied.

National Academy of Sciences (*Proceedings*):

May 1939.—SIR SHAH SULAIMAN: *The theory of a new relativity, Chapter XVI (Generalised Gravitation).* GIRJA DAYAL SRIVASTAVA: *Contribution to the morphology of* Orobanche ægyptiaca *Pers.* SIKHIBHUSHAN DUTT: *Composition of patent still molasses fusel oil of Indian origin—Part II.* JAGAT NARAIN TAYAL AND SIKHIBHUSHAN DUTT: *Chemical examination of the seeds of* Martynia diandra. *Composition of the fixed oil.* JAGRAJ BEHARI LAL: *Constitution of santalin.* A. B. SEN: *Migration of para halogen atom in a derivative of meta-cresol.* IONE NITRAVATI DHARAM DASS AND SIKHIBHUSHAN DUTT: *Colour in relation to chemical constitution of the organic and inorganic salts of iso-nitrosomalonyl-guanidine.*

August 1939.—RAM KRISHNA MEHRA: *New monostomes of the family pronocephalidæ looss,* 1902. R. N. MITTRA: *Formation of periodic precipitate in the absence of a foreign gel—Part III. Ferric phosphate and ferric arsenate sols.* R. N. MITTRA: *Formation of periodic precipitate in the absence of foreign gel—Part IV. Ferric borate sol.* S. N. BANERJI AND S. GHOSH: *Changes in the viscosity of agar sol with concentration.* S. N. BANERJI AND S. GHOSH: *Changes in the viscosity of agar sol with temperature.*

Mining, Geological and Metallurgical Institute of India (*Transactions*):

The recent number of the *Transactions of the Mining, Geological and Metallurgical Institute of India* (Vol. 35, Pt. 4, February 1940) contains three important papers; one by DRS. F. G. PERCIVAL AND E. SPENCER on *Conglomerates and Lavas in the Singhbhum-Orissa Iron Ore Series;* the second by MR. B. WILSON HAIGH on *Coal Carbonisation and Some of its By-products,* and the third on *Mineral Wool* by DR. M. S. KRISHNAN. The first paper deals with certain aspects of the geology of an area which has been attracting considerable attention within recent years. The second paper gives an account of the carbonisation of coal at high, medium and low temperatures, with special reference to the by-products derivable therefrom. The paper on Mineral Wool by Dr. M. S. Krishnan is of exceptional interest, and from

what the author says, it is clear that there is a vast field in India for the production and utilisation of 'rock wool', forming the basis of a new and useful industry.

The Journal also contains a Report of the Discussion on Mr. M. M. Mukherji's paper on the *Correlation of the Satpukuria Seam in the Raniganj Coal Field.*

Geological, Mining and Metallurgical Society of India (*Journal*):

The latest number of the *Quarterly Journal of the Geological, Mining and Metallurgical Society of India* (Vol. XI, No. 3, September 1939), begins with the Annual Report of the work done by the Society during the year 1938–39, which is followed by the Presidential Address by Jhaveri Lal K. Dholakia on National Planning in relation to Geology, Mining and Metallurgy, in which he gives a review of the present position in the matter of mineralogical and metallurgical industries in India and indicates the lines on which further developments should proceed. The *Journal* also contains 5 other short papers of interest among which may be mentioned *A Note on the Metamorphic Rocks in Southern Konkan* by MESSRS. K. V. KELKAR AND W. P. PATANKAR; *Micro Structure of Some Indian Fusain* by MR. N. N. CHATTERJI, and *Geology of the Chromite Deposit of Jojohatu, Singbhum* by MR. B. S. BAHADURIA. The Secretaries' Report is a record of much useful work done by the Society during the year in Geology and allied branches of knowledge.

Indian Botanical Society (*Journal*):

June 1940.—R. E. COOPER AND R. R. ULLAL: *The study of the effect of a mixture of two parts of blue-violet rays and one part of white light on the formation of carbohydrates in leaves.* A. M. SUBBA RAO: *Studies in the Malpighiaceæ—I. Embryo-sac development and embryogeny in the genera* Hiptage, Banisteria *and* Stigmatophyllum. L. B. KAJALE: *A contribution to the life-history of* Bergia ammanioides *Roxb.* SULTAN AHMAD: *Higher fungi of the Punjab plains—II. The Gasteromycetes.* C. V. KRISHNA IYENGAR: *Development of embryo-sac and endosperm-haustoria in some members of Scrophularineæ—IV.* Vandellia hirsuta *Ham. and* V. scabra *Benth.* M. O. P. IYENGAR: *On the formation of gametes in Caulerpa.* M. O. P. IYENGAR AND K. R. RAMANATHAN: *On sexual reproduction in a Dictyosphærium.* B. SAHNI: *Palæobotany in India—Progress Report for* 1939. P. R. BHAGAVATHI KUTTY AMMA AND T. EKAMBARAM: *Sugarcane × Bamboo hybrids.* S. C. DIXIT: *The Charophytes of the Bombay Presidency—II.* D. P. MULLAN: *The Anatomy of* Spinifex squarrosus *Linn. with special reference to the morphology of the leaf-blade.*

Royal Asiatic Society of Bengal:

July 1, 1940.—D. N. MAJUMDAR: *Some aspects of the cultural life of the Khasas of* cis-*Himalayan region.* The Khasas of Jaunsar Bawar, included in the Chakrata subdivision of the Dehra Dun District in the United Provinces, are a polyandrous people. There is ample evidence of the physical similarity of the Khasas with the Kashmiris, and the Khasa family law resembles the Punjab customary law, particularly that of the Kangra hills. They represent, most probably, the easternmost outpost of Indo-Aryan penetration in the *cis*-Himalayan region. The social organization in Jaunsar Bawar is characterised by a dual organization of economic classes, *viz.*, the zemindars and the artisans. The latter are mostly recruited from the aboriginal substratum perhaps of "Austric" speaking stock. Religious life of the Khasas is a curious blend of Hindu and tribal beliefs and practices and though they own allegiance to Hindu divinities their partiality to ancestral spirits, queer and fantastic demons and gods, stones, weapons and various symbols, is rather phenomenal. The Khasas are a patriarchal people living in a joint family under the authority of the eldest brother. The polyandry of the Khasas is also of the fraternal type. There is a disparity in the distribution of the sexes and the fertility of women has considerably fallen in recent years; the proportion of the male children is greatly in excess of females. The functional analysis of the group morals and customs connected with polyandry leads to the irresistible conclusion that the *cis*-Himalayan region is characterised by an impact of two distinct matrices, one matriarchal represented by the Domas or the aboriginal substratum and the other patriarchal represented by the Khasas.

Among other papers read at the meeting, mention may be made of the paper by Dr. A. Aiyappan, on "Siva-Seal of Mohenjo-Daro".

Meteorological Office Colloquium, Poona:

June 11, 1940.—A. K. ROY: *Application of Wet-bulb potential temperature to Airmass analysis.*

June 18, 1940.—B. N. DESAI: *The results of analysis of surface and upper air data relating to a Bay storm of November* 1935.

June 25, 1940.—C. P. MENEZES: *The currents of the Indian ocean.* S. N. ROY-CHOWDHURY: *Sea-breeze at Karachi.*

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HIS LATE HIGHNESS MAHARAJA
SRI KRISHNARAJA WADIYAR BAHADUR, G.C.S.I., G.B.E.
MYSORE
(4TH JUNE 1884 — 3RD AUGUST 1940)

CURRENT SCIENCE

Vol. IX] AUGUST 1940 [No. 8

HIS LATE HIGHNESS MAHARAJA SRI KRISHNARAJA WADIYAR BAHADUR, G.C.S.I., G.B.E.

(*4th June 1884—3rd August 1940*)

WITHIN a short period of less than five months, the Royal Family of Mysore and the people of the State have sustained two grievous losses. By the death of His Highness Maharaja Krishnaraja Wadiyar Bahadur, the British Empire has lost a loyal friend; India, a remarkable personality; the Princes, a great exemplar of their Order; Mysore, a wise, sagacious and patriotic ruler; the Royal Family, a gracious protector. It may well be that when we look back on that noble life of devoted service to the State, and of the perpetual triumph of the soul over the trials, which an unkind fate had brought upon it, that, late in the evening of that fatal Saturday, some may have heard the faint echoes of the trumpets sounding the retreat for him. It was now between nine and ten in the night. The Maharaja closed his eyes. A noble end terminated a noble career. There were assembled about him his relations, for whom he cherished affection; friends of his youth, who had been true to him; officers who had served him with fidelity. A star of the first magnitude has gone from the world of princes, leaving an after glow in its place.

It will be remembered that Mahatma Gandhi, an incisive and acute critic of the Princely rank, once characterized the administration of the late Maharaja of Mysore as "RAMA RAJYA". The Mahatma scarcely indulges in rhetoric or flattery, and never palters with truth. While there can be nothing more remarkable than the accuracy of this critical and unbiased estimate, it must be borne in mind that one of the keys to the life of His late Highness was that his roots had struck deep into the ideals of the saintly and philosophic rulers of ancient Puranic India, and that it was

from this source that he drew his inspiration and strength. Convinced that the guardianship of the destinies of his people had been entrusted to his care by Almighty, His late Highness, while discharging the responsible duties attached to his high station, sought for His approbation by silently and unostentatiously building for himself a strong and enduring place in the hearts of his people. To the long succession of generations yet unborn in Mysore, the name and example of one of the greatest rulers in modern India, whose reign has just ended, will be as much a source of inspiration, as they have been held in reverence by those to whom the loss is still fresh. When History focuses her hard light upon the life and character of Maharaja Krishnaraja Wadiyar Bahadur, and upon the many notable achievements of his long and eventful reign, covering a period of thirty-eight years, during one of the most critical phases of the political development of India, she will remember the name of this great prince with the other illustrious rulers of the lunar race.

At an age when young men are still pursuing their studies in schools and colleges, His late Highness was summoned to assume the governance of a State, larger than most of the independent principalities of Europe, and he brought to bear on his office a rare combination of gifts,—not common among men of maturer experience,—gifts, with which nature had endowed him in profusion, such as wisdom, sagacity, judgment and statesmanship. Before he was ten years old, Providence had deprived him of watchful paternal guidance, which naturally passed to the wardenship of the Regent Maharani. The Prince's early education took the form of a silent process of implanting into his mind the principles of religion and virtuous conduct; and the officially appointed tutors trained him in all branches of learning, and in the theory and practice of administration. Ceaseless study from early years, intercourse with eminent men and extensive travels had greatly enriched his natural abilities and it is therefore little wonder that he was able to enter upon the arduous duties of his office, when at the age of eighteen, he ascended the throne of his predecessors. His late Highness was generally supposed to have been reticent and reserved, which, however, did not prevent him from unbending.

He was a competent exponent of all branches of fine arts, and recognised and rewarded merit in others. Possessing an excellent physical constitution, he patronised and participated in every form of manly exercise and sport. Being of a philosophical turn of mind, he was an ardent scholar of Indian and Western metaphysical classics. Always devout, His late Highness observed the usages of the ancient Hindu religion in all the festivities and ceremonies, annually celebrated in his court. He had a generous tolerance towards the customs and practices of the diverse religious creeds of his numerous subjects. Though by natural aptitude, his mind was moulded in the pattern of ancient Hindu culture, His late Highness was greatly alert in assimilating the progressive spirit of all that was best in the Western science, literature and politics. In all his public speeches are discernible the marks of his wide and varied learning, and of a powerful and balanced mind, devoted to constant enquiry and to the sifting of values. As his gifts were rich and his interests, exceptionally wide and varied, so it is that the death of this eminent ruler must necessarily leave many gaps in the public life of this country.

The high political prestige which Mysore enjoys to-day is due to the progressive policy adopted by His late Highness and his gifted Dewans. When he ascended the throne in 1902, he found that, under the late Sri Chamaraja Wadiyar Bahadur and later of the Regent Maharani, the

State had already attained a high degree of administrative efficiency, under the stewardship of Rangacharlu and Seshadri Iyer, who laid the foundation of the political and economic structure of the State. Dewan Rangacharlu instituted the Representative Assembly which introduced a popular element in the administration. Dewan Seshadri Iyer is gratefully remembered for his bold policy of inaugurating great schemes of public utility, which gave a definite impetus to the economic advancement of the State and its people. In the year 1907, the Legislative Council was established, which marked a further forward step in associating the elected representatives of the people with the Government. Between the years 1909 and 1919, during which Sir M. Visvesvaraya was associated with the State, first as Chief Engineer and later as Dewan, public life was galvanized into an unprecedented activity in every sphere. His period of office marked a distinct turning point in the economic and industrial development of Mysore, which inspired new ideals in public life, and gave a fresh outlook to the aspirations of the people. Like his brilliant predecessor Sir K. Seshadri Iyer, he was exacting towards others collaborating with him, and he demanded a very high standard of efficiency, but he was not nearly so exacting towards others as he was towards himself. The second stage in the history of Mysore began when Sir Mirza M. Ismail became Dewan. The commencement of his regime was characterized by an immediate manifestation of energy in the various departments of the State, and it was apparent that a period of rapid reforms and progress had been inaugurated. His sobriety, self-command, soundness of judgment, perfect rectitude of intention and patriotic devotion to the ruler and unremitting zeal in the promotion of the best interests of the State have won for him popularity and reputation both in the State and abroad. The achievements with which his name is associated cover an extensive ground;—in the field of public health administration, the campaign he has initiated for the alleviation of human suffering; in the region of rural reconstruction, the measures adopted for the economic regeneration of the poor villagers; in the realm of industry and engineering projects of great public beneficence, the institution of numerous works for utilising the material resources of the State and in the domain of cultural, political and æsthetic development of public life, the bold and enterprising schemes undertaken and executed;—these and others constitute a notable record in the administrative annals which furnish few parallels even in British India.

The rule of His late Highness Sri Krishnaraja Wadiyar Bahadur, forms a towering peak on the map of Mysore. He was the architect of modern Mysore. He brought his subjects material prosperity and security, which fact alone is justification enough for placing His late Highness among the galaxy of the great Indian rulers. The mantle of the illustrious uncle has descended to the equally great nephew. The ministers who served His late Highness devoutly and loyally, stand by the young Maharaja with the same steadfastness and fidelity. The people, who cherished veneration for the late Maharaja, own deep devotion to His Highness Maharaja Sri Jaya Chamaraja Wadiyar Bahadur. They anticipate that the new rule, which has commenced, will witness increasing prosperity in the State, and they hope and pray for peace, happiness and glory for the young Maharaja and the Royal Family.

PYRETHRUM CULTIVATION IN KASHMIR

BY

M. R. FOTIDAR

(*Department of Agriculture, Srinagar*)

PYRETHRUM constitutes a genus of *Chrysanthemum* in Compositæ family and is said to constitute a hundred species, out of which a few are toxic to insects. The principle specie, commercially important, is *Pyrethrum cinerariæfolium*. The plant ordinarily resembles the field daisy, particularly the flower which is apparently similar to the daisy in size, shape and colour. The plant is perennial and grows 18 to 20 inches high. Stems are unbranched and slightly hairy. Leaves are petiolate and finely cut. The flower heads consist of rounded receptacles, a straw coloured involucre composed of three rows of scales and a disc containing numerous yellow flowers with a circle of yellow or cream coloured ray flowers. The ray florets are ligulate, pistillate with cream or white coloured corolla. These florets are delicately veined and exhibit three teeth at the tip. The disc florets are yellow, tubular, perfect and have five lobed corolla borne on the achene. The flowers vary from 6 to 24 mm. in diameter.

The dried crushed flowers have a pleasant, characteristic odour due to the presence of essential oil which is pronounced in the freshly prepared material. It has acrid, bitter taste and causes numbing sensation to the tongue and lips, which is due to the active principal present in the plant. The active principal is called pyrethrin, which is said to exist in two forms. Both these forms are mineral oil soluble.

The use of pyrethrum flowers in powdered form and its extraction is known since earlier days. At present very large quantities of the flowers are utilised in U.S.A. and other Occidental countries.

The plant is cultivated on a commercial scale in Dalmatia (Yugoslavia), Japan, Kenya, some parts of Italy, United Kingdom and Russia. Japan and Kenya are the two principal producing countries.

Since last several years the use of this insecticide has been found practicable as a control against mosquitoes. The adults readily succumb when the pyrethrum extract is sprayed on them, as is evident by the so-called commercial 'Flit'. Flit is a mineral oil extract of Pyrethrum.

India has been importing flowers from Kenya in considerable quantities.

The Imperial Council of Agricultural Research having recognised the possibilities of its local demand, took necessary steps for the introduction of pyrethrum cultivation in India. Seeds in small quantities were imported and distributed to various provinces and the constituent States in the year 1937.

The Department of Agriculture started its cultivation under the auspices of The Imperial Council of Agricultural Research. This is the third year of the plantation. From the present harvest which has been just completed we have more than half a maund of seed, besides some quantity of dried flowers for experimentation. The last two years' experiments have shown:—

1. Seeds sown in well-prepared nursery beds in spring, early summer and autumn germinated well, although the early summer percentage was 50 per cent. less than that of spring and autumn.
2. From 1 lb. of seed we obtained about 15,000 seedlings.
3. The seedlings were transplanted after 4 or 5 weeks, one and a half foot apart either way. Seedlings can be planted both in spring and autumn.
4. Very little irrigation is needed. In fact too much irrigation or plenty of rain damages the plant.
5. The crop could be multiplied by subdividing the one year or two year old plants, and the area as such could easily be multiplied 4 to 6 times.
6. The flowers are ready for harvesting in the beginning of June. The flowers ripen for seed production sometimes in the middle of July.
7. In the first year of plantation, very few flower heads are produced, second and third year gives increased yields. In the second year we obtained as much as 300 lb.

of flowers per acre, and some of the individual bushes did yield 500 flower heads.

8. The flowers were sent for trial purposes to The Malarial Institute of India, who have found the specimen equivalent to the Kenya ones in biological test. It is said to have contained about 1 per cent. pyrethrin.

9. The vitality of the seed has not been affected by storage for one complete year so far.

Other cultural experiments including manuring under irrigated and unirrigated conditions in different classes of soils have been started at about a dozen centres. It is expected that the cultivation of pyrethrum will be started on a very large scale during the coming season.

The Forest Department had taken up the cultivation earlier and this year they have brought an area of about 200 acres under this crop.

Small samples of five other varieties namely *P. roseum; P. parthenium; P. cineraria; P. carneum; P. lencopiloides* have also been received from The Imperial Council of Agricultural Research. Out of these only two, *i.e.*, *Pyrethrum roseum* and *Pyrethrum parthenium*, succeeded well. As a plant, none of these can compare well with *Pyrethrum cinerariæfolium*. Samples of flowers are collected and will be sent for biological test.

OBITUARY

THE HON'BLE SIR ALFRED GIBBS BOURNE, K.C.I.E., D.Sc., F.R.S., F.L.S.

(1859–1940)

MANY of the old students of Sir Alfred Bourne will doubtless grieve to hear of the sad news that he passed away. He was comparatively young when, in 1886, he arrived in Madras to join the Presidency College as Professor of Biology which he held till 1898. During this period, however, he acted on several occasions as Registrar of the Madras University and as Superintendent, Government Museum. On relinquishing the professorial chair in 1903 he was made Director of Public Instruction and Commissioner for Government Examinations, with provision for a seat in the Legislative Council. He retired from this office in 1914.

Sir Alfred Bourne established a great reputation both as a teacher and as an investigator. Before he landed in India, he had published important memoirs on zoological subjects and his brilliant work in India enabled him at an early age to be elected into the Royal Society. His many students will remember that though he was a man of few words there beat within him a true human heart, and in the spirit of a loving teacher he exerted his influence to advance their interests. In his capacity as Director of Public Instruction his constant endeavour had been to expand secondary education to which modern sides were added. He introduced the Secondary School Leaving Certificate system. As Chairman of the first university inspecting commission his report is a document of great importance and lucidity and some of the recent reforms in the university education can be traced to his labours.

After retiring he was summoned to assume charge of the Indian Institute of Science as its Director, which post he held with conspicuous distinction from October 1915 to March 1921.

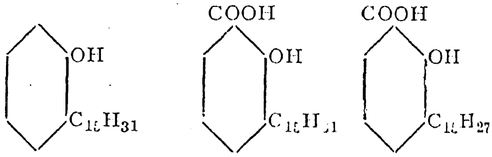
Sir Alfred Bourne may not have come into personal contact with a very large body of students in South India. But nevertheless, the few that came under his direct influence will remember the many excellent qualities of that brilliant scientist who commanded a raging popularity and widespread esteem. His name and work in Madras will be remembered for a long time in grateful appreciation.

LETTERS TO THE EDITOR

The Constitution of Anacardic Acid, the Principal Constituent of Cashew-Nut Shell Oil

Cashew-nut shell oil from the pericarp of the seed of cashew-nut tree—*Anacardium occidental*—is an article of great commercial value. A small part of the oil produced in India is used locally as a preservative coating for country boats, wooden floors, and fishing nets, major portion being exported to America for the manufacture of insulating varnishes, lubricating oils, synthetic resins, etc.

Stadeler[1] who first studied the chemical composition of this oil, separated the acid constituent called "Anacardic Acid" and the neutral one, "Cordol". Ruheman and Skinner[2] later established the correct molecular formulæ of anacardic acid as $C_{22}H_{32}O_3$. Smit[3] suggested that anacardic acid is a penta-deca-dienyl-salycylic acid $C_6H_4.OH.COOH.C_{15}H_{27}$. On catalytic hydrogenation of anacardic acid he obtained tetrahydroanacardic acid from which by decarboxylation, tetrahydroanacordol was obtained. The presence of a hydroxyl group and a pentadecyl side chain was established by him, but the ortho-position of the pentadecyl side chain to the hydroxyl group was suggested by him by mere analogy with pelandjauic acid.[4] According to him, therefore, the following are the structures of tetrahydroanacordol, tetrahydroanacardic acid and anacardic acid.



Tetrahydroanacordol Tetrahydro-anacardic acid Anacardic acid

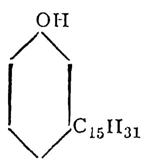
Later P. P. Pillay[5] also studied the constitution of anacardic acid and obtained results similar to those of Smit's. Further he claims to have isolated salicylic acid as a product of potash fusion of phenol obtained by destructive distillation of anacardic acid and hence he has also assigned the alkyl chain an ortho-position to hydroxyl group. This evidence appears to be of doubtful nature as under the drastic

conditions employed, the possibility of intramolecular changes cannot be overlooked. The authors in order to get conclusive evidence on this point have now synthesised o-pentadecyl phenol which according to Smit and Pillay[6] should be tetrahydroanacordol.

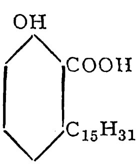
By Fries transformation of phenyl-pentadecylate are obtained *o*-hydroxy-pentadecaphenone and *p*-hydroxy-pentadecaphencne which on reduction by Clemmensen's method give *o*-pentadecyl-phenol and *p*-pentadecyl-phenol. Although *o*-pentadecyl-phenol (m.p. 54°–55° C.) and tetrahydroanacordol (m.p. 53°–54° C.) have very similar melting points, they are quite different in nature and chemical properties and by direct comparison of the two and their corresponding three derivatives, they are proved to be unidentical. Further tetrahydroanacordol (m.p. 53°–54° C.) is found to be not identical also with *p*-pentadecyl-phenol (m.p. 72·5° C.).

As the presence of a hydroxyl group and a pentadecyl side chain in tetrahydroanacordol has been definitely established by both Smit and Pillay[7] the only structure that can possibly be given to it is that of *m*-pentadecyl-phenol. This conclusion is experimentally supported by the fact that like *m*-alkyl phenols, tetrahydroanacordol forms a tribromo derivative while ortho and *p*-pentadecyl phenols form dibromo derivatives.

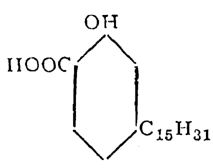
This conclusion is finally established by the oxidation experiments on methyl ether of anacordol which led to *m*-methoxy-benzoic acid. This finally establishes the constitution of tetrahydroanacordol to be *m*-pentadecyl phenol.



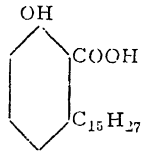
The possible structures of tetrahydroanacardic acid are therefore:



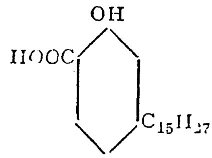
or



and the corresponding possible structures of anacardic acid are:



or



G. D. Gokhale.
M. S. Patel.
R. C. Shah.

The Royal Institute of Science,
Bombay,
June 27, 1940.

[1] *Das Annelen der chemie und der pharmacie*, 1847 **63**, 137.
[2] *J.C.S.*, 1887, T. **663**.
[3] *Proceedings K. Akad. Wetenschappen*, Amsterdam, 1931, **34**, 165.
[4] P. Van Romburgh, A. G. Van Veen and A. G. H. Smit, *Proc. Akad. Sci.*, Amsterdam, 1930, **33**, 589–94.
[5] *J. Ind. Chem. Soc.*, 1935, 226.
[6] *Loc. cit.*
[7] *Loc. cit.*

Changes of Atmospheric Electric Potential Gradient during Monsoon Rains in Bombay

It is well known that the fair weather positive atmospheric electric potential gradient often changes its sign during disturbed weather. Rain with or without thunderstorms is mostly associated with negative potential gradient.[1] The changes of potential gradient accompanying rainfall in the monsoon months in Bombay are generally simpler in character than those associated with thunderstorms. The present note gives an analysis of the potential gradients accompanying the rains of the monsoon season.

The data were tabulated from the electrograms (obtained with a photographic electrograph of the Cambridge Instrument Co.[2]) and rainfall charts of the Colaba Observatory during June to September in 1937 and 1938. Complicated changes such as occur during thunderstorms have not been considered in detail. The results of the analysis are given in Table I.

TABLE I

Changes of potential gradient accompanying monsoon rains at Colaba, Bombay

June to September 1937 and 1938

MONTH		NUMBER OF OCCASIONS WITH							Total Number
		Pot. grad. negative A	Pot. grad. mostly negative but with positive for a small part of the time	Pot. grad. positive but with deminished value B	Sum of cols. 2, 3 & 4	Pot. grad. with increased positive value C	Pot. grad. almost unaffected	Miscellaneous change, not classifiable in any of the previous categories	
June	1937	58	5	45	108	1	18	8	135
,,	1938	41	17	46	104	4	20	12	140
July	1937	79	14	96	189	15	58	12	274
,,	1938	49	3	71	123	6	27	16	172
Aug.	1937	20	0	39	59	6	23	0	88
,,	1938	36	8	43	87	7	23	5	122
Sept.	1937	25	0	13	38	10	6	0	54
,,	1938	21	1	6	28	0	11	2	41
TOTAL ..		329	48	359	736	49	186	55	1026

It will be seen that the potential gradient became negative in nearly 35 per cent. of the cases; in another 35 per cent., although the gradient did not change sign, the positive value showed a decrease. Change of sign occurred with heavy showers and a decrease of positive gradient (without change of sign) occurred with light showers and drizzles. The instances in which the potential gradient changed sign (group A) can again be divided broadly into two classes, (1) those in which the gradient was immediately reversed with the onset of rain and recovered to the normal gradient when rain ceased and (2) those in which the gradient increased either immediately before or at the beginning of the rain and then steeply reversed and came back to the normal value at the cessation of rain. In a few cases, an increase in potential gradient was observed towards the end of the shower. It is also interesting to note that in about 5 per cent. of the cases studied the monsoon rain had the effect of increasing the positive gradient; in such cases the showers were smart and the changes of gradient lasted for brief intervals, the normal gradient shooting up at the commencement of rain and falling down to the normal value when rain ceased.

A few electrograms showing the typical changes of potential gradient and corresponding syphon rain-gauge charts, are reproduced (Figs. 1–6). It will be seen that the potential gradient changed sign and remained negative during rain at positions marked "A"; at A_1 the gradient, before becoming negative, shot up to higher positive values at or before commencement of rain; and at "A_2" the increase in gradient occurred only towards the end of the rain. At "B" the gradient registered a lower value during rain and at "C", the gradient shot up momentarily to higher positive values during smart showers.

During the period under investigation there

Typical electrograms and corresponding rainfall charts—Bombay

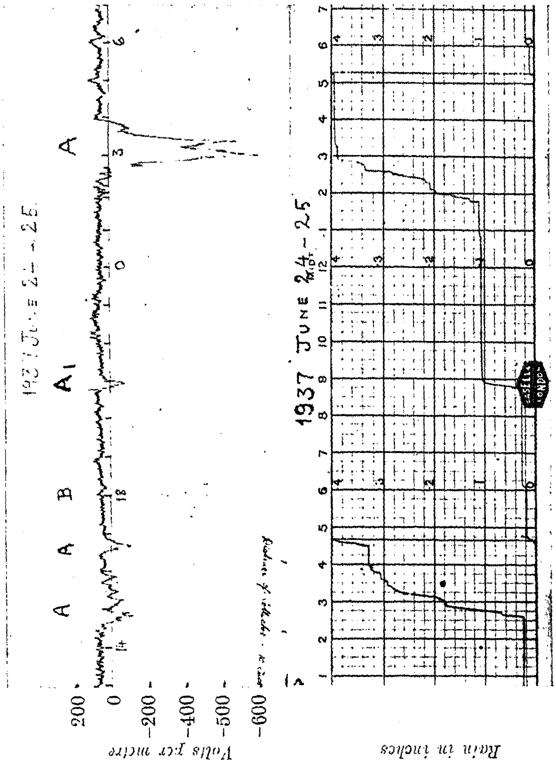


Fig. 2

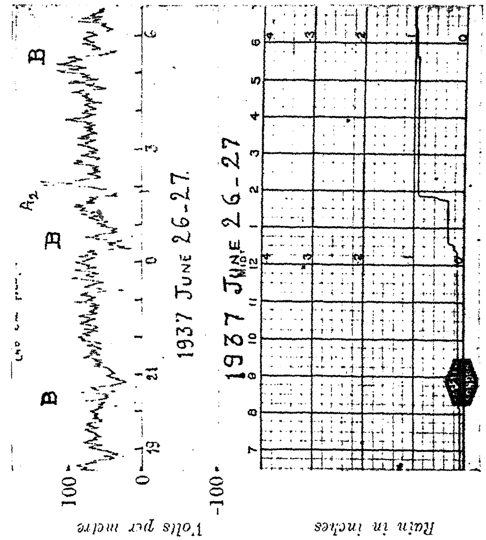


Fig. 4

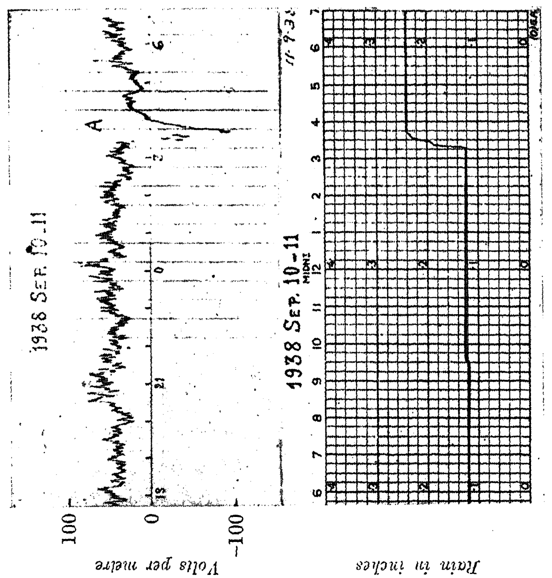


Fig. 1

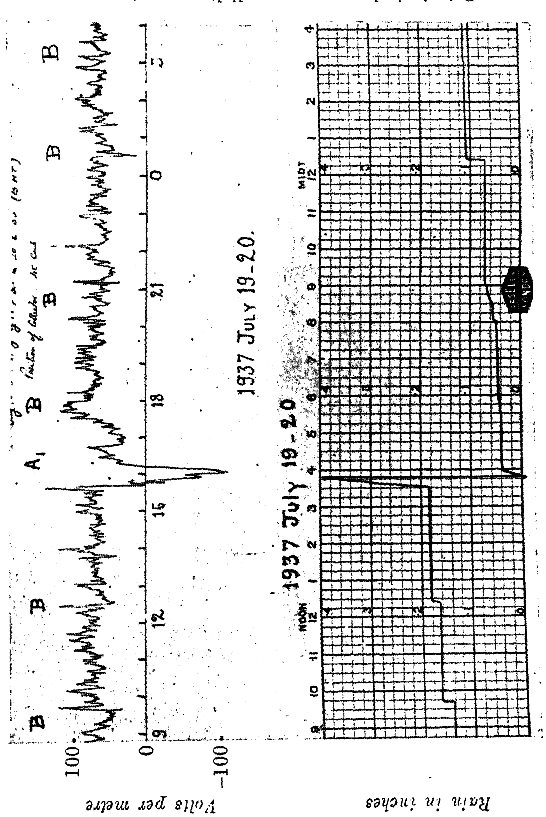


Fig. 3

Typical electrograms and corresponding rainfall charts—Bombay (*Continued*)

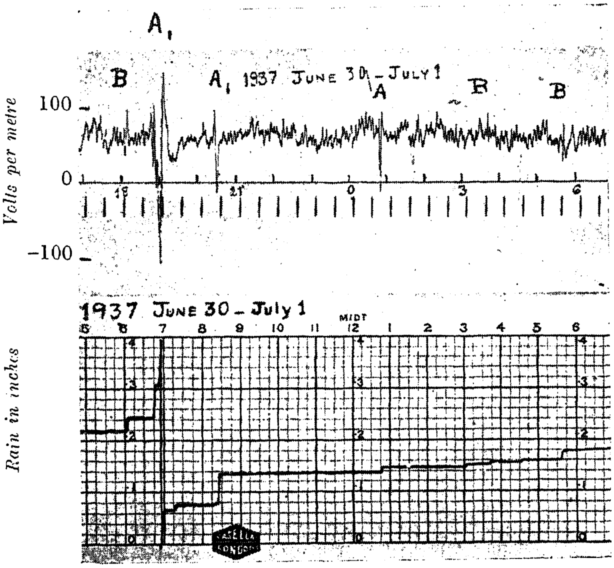


FIG. 5

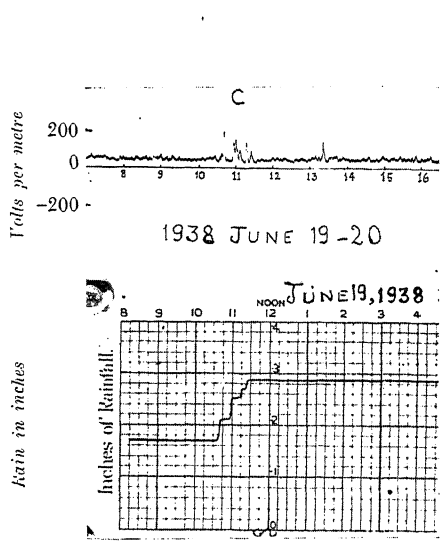


FIG. 6

were 20 occasions when the gradient was negative when no rain was recorded by the rain-gauge of the Observatory. These are mostly due to charged clouds passing over the Observatory. On the whole, the potential gradient data are consistent with the view that monsoon clouds have a distribution of charges similar to that of thunderstorm clouds with a preponderance of negative charge near the base of the cloud. Simpson and Scrase[3] found evidence in some thunderclouds of a concentration of positive charges in a limited region of the base of the cloud. The occasional positive gradients found beneath monsoon clouds are perhaps due to the existence of a similar distribution of charges in monsoon clouds.

My thanks are due to Dr. K. R. Ramanathan for suggesting this study and for his kind interest in the work.

A. R. PILLAI.

Colaba Observatory,
Bombay,
July 20, 1940.

[1] Schonland, B. F. J., *Atmospheric Electricity*, p. 62.
[2] *J. Sci. Inst.*, **5**, pp. 145–52.
[3] Simpson, Sir G., C., and Scrase, F. J., *Proc. Roy. Soc.*, 1937, A, **161**, 309.

Determination of Peroxidase Activity

It was reported previously[1] that ascorbic acid oxidase in drumstick is accompanied by peroxidase. In subsequent experiments on the separation of these two enzymes, the need arose for a rapid method of determining peroxidase activity. The method of Willstätter and Weber[2] could not adequately supply the need. Search among other known methods suggested that the one based on the oxidation of benzidine to purpuro-benzidine[3] might be simple and rapid. On actually trying out this method, it was found, however, that the filtration of the dye, prior to its dissolution in alcohol, was tedious and time-consuming. Obviously these difficulties could be overcome by the use of an immiscible, high-boiling solvent for dissolving out the purpuro-benzidine quantitatively from the reaction mixture. It was observed that butyl alcohol admirably fulfilled these requirements. Based on this observation, the original method of Zirm *et al.*,[3] has been modified as under:—

To 50 c.c. water in a 100 c.c. separating funnel (short-stem) are added in succession (*a*) 2 c.c. of 1 per cent. benzidine in sodium acetate-

acetic acid buffer (pH. 3·5 — 3·65), (*b*) enzyme solution and (*c*) 1 c.c. H_2O_2 (1·8 mg.). The reaction is carried out at 30° C. for 5 minutes, and then stopped by addition of a 25 per cent. solution of NaOH till the solution changes from a blue to orange red colour (about 2 c.c. of alkali are required). On saturating the inactivated reaction mixture with NaCl, the dye is thrown out. This is extracted with 5 c.c. butyl alcohol. The alcohol layer containing the dye is separated and after washing once with saturated brine is drawn into a 25 c.c. flask through a filter of cotton wool (to keep out undissolved, mechanical impurities, if any). The separator is washed several times with small quantities of ethyl alcohol to complete extraction of the dye and each washing passed through the original filter. The combined filtrates are made up to 25 c.c. with ethyl alcohol. A control is run under identical conditions but with the boiled enzyme. The amount of purpuro-benzidine formed is determined in the Pulfrich Photometer (cell 20·06 mm., filter

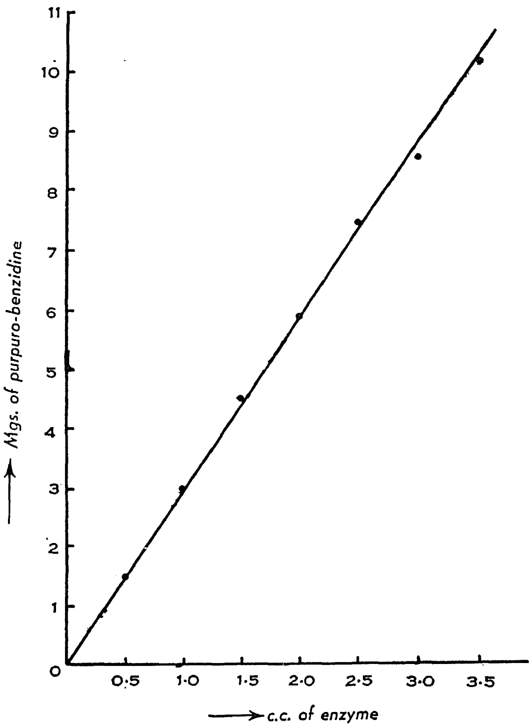


FIG. 1

S 53) and evaluated by reference to a previously constructed standard-graph: Purpuro-benzidine *vs.* Extinction Coefficient.

The peroxidase activity of *Chow-Chow* (*Sechium edule*) enzyme extract has been determined by this method.

The graph (Fig. 1) proves that under the conditions of the experiment the amount of dye formed is strictly proportional to enzyme concentration. Consequently, for the range of enzyme concentration studied, the quantity of purpuro-benzidine which is determined, gives us an exact measure of peroxidase activity.

M. SRINIVASAN.
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M. SREENIVASAYA.

Department of Biochemistry,
Indian Institute of Science,
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July 5, 1940.

[1] Srinivasan, M., *Biochem. J.*, 1936, **30**, 2077.

[2] Willstätter and Weber, *Annalen der Chemie.*, 1926, **449**, 156.

[3] Zirm, K. L., Reuter, F., and Willstardt, H., *Biochem. Z.*, 1932, **245**, 290.

A Note on the Determination of Lead Permanganometrically (Low's Method)

HEMPEL's method[1] as modified by Low[2] has been in use for a long time for the determination of lead permanganometrically in technical analysis. Low's method has also been adopted by the British Pharmacopea. This method which consists in precipitating the lead as oxalate from acetic acid solution, dissolving the precipitate in dilute sulphuric acid and titrating with permanganate has been criticised by Morris[3] and Wetherell[4] on the grounds that precipitation is incomplete unless carried out from a 60 per cent. acetic acid solution, and that the liberation of oxalic acid from the precipitate by dilute sulphuric acid is not quantitative. Other investigators have frequently suggested variations in procedure such as filtering on asbestos and using dilute nitric acid for the solution of the lead oxalate before the

addition of sulphuric acid. All these modifications very frequently give low results.

Coppock and Coppock[5] attributed the low results to the greater solubility of lead oxalate than calcium oxalate. However, it is evident from the data given by Riesenfeld,[6] and Kohlthoff and Furman[7] that the reverse is the case and hence the low results obtained by Low's method could not be due to this cause. Further, though the instability of dilute solutions of oxalic acid has been pointed out by several investigators, contradictory statements are found in the literature regarding the oxidisability of oxalic acid by chlorine, and nitric acid.

It has now been found that 60 per cent. acetic acid is unnecessary for quantitative precipitation of the lead oxalate, and that the use of nitric acid for solution of the lead oxalate is inadmissible as it oxidises the oxalic acid. Regarding the non-quantitative liberation of oxalic acid from the precipitate by dilute sulphuric acid, it has been found that this acid is best replaced by hydrochloric acid not only for the solution of the precipitate but also for the subsequent titration. As long as the concentration of the hydrochloric acid is well below IN, no appreciable oxidation of this acid occurs under the conditions of an oxalate-permanganate titration. A detailed account of the investigation will be published later.

The author wishes to thank Professor T. R. Seshadri for helpful criticism in the preparation of this note.

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Department of Chemistry,
Andhra University,
Waltair,
July 11, 1940.

[1] Hempel, *Jahresbericht*, 1853, 627.

[2] Low, *J. Am. Chem. Soc.*, 1893, **15**, 550; *cf.* A. H. Low, *Technical Methods of Ore Analysis*; and Scott, *Standard Methods of Chemical Analysis*.

[3] Morris, *Chem. and Drug.*, 1919, **91**, 52.

[4] Wetherell, *Quart. J. Pharm.*, 1935, **8**, 453.

[5] Coppock and Coppock, *Volumetric Analysis*, 1934.

[6] Riesenfeld-Ray, *A Manual of Practical Inorganic Chemistry*, 1933, p. 449.

[7] Kohlthoff and Furman, *Volumetric Analysis*, 1928, p. 271,

Structure of the (3, 0) Band λ2569 of the OD Molecule

In continuation of the work on the structure of the OD bands of Heavy Water reported previously[1] the (3,0) band at λ2569 has been photographed and measured. On account of the relatively small intensity of the band, exposures for about four hours have been found necessary using the medium Hilger Quartz Spectrograph (dispersion 10 Å per mm. approx. at λ2600). The band corresponds to the one at λ2447 of OH, due to the electronic transition $^2\Sigma^+ \rightarrow {}^2\pi_{\text{inv}}$. The rotational structure has been analysed and the six main P, Q, R, branches are derived. The values of the constants have been calculated to be (in cm.$^{-1}$)

$$B'_3 = 8 \cdot 13 \qquad B''_0 = 9 \cdot 94$$

Details of the structure will be published elsewhere.

M. G. SASTRY.

Andhra University,
Waltair,
July 14, 1940.

[1] *Curr. Sci.*, 1940, **9**, 172; 1940, **9**, 225. *Nature*, 1940, **145**, 778.

Typical Colour Curves and their Application for Purity Tests in Physiological Researches

In a recent communication[1] from these laboratories a new Photoelectric Photometer was described for chemical analysis, based on the measurement of light absorption of the solution of substance occasioning a colour reaction, within a narrowly defined region of the spectrum with the aid of a quantitatively variable light diminution; photoelectric cells (Caesium Becker & Co.) being used to indicate equivalence of light.

A successful application of the above instrument for purity tests based on colour measurements has been in an examination of chlorophyll solutions for carotenoid impurities. Carotin has a characteristic absorption in the region 560–430$\mu\mu$, the corresponding band for chlorophyll

being 750–570$\mu\mu$ (Fig. 1). It has been found by us that Beer's law holds for these mixtures and a straight line relation is obtained between the change in the logarithms of the extinction coefficient K of the mixture and the percentage of carotin, at a wave-length of 470$\mu\mu$. Curves 1 and 2 in Fig. 1 have been obtained with

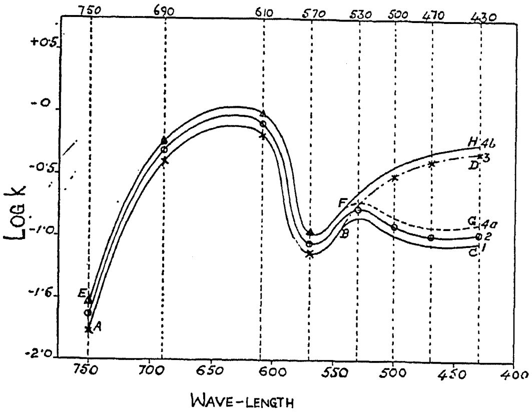

Fig. 1

Typical colour curves of chlorophyll solution in 80 per cent. methyl alcohol. Curve 1, (A B C) 4 mg. in 100 c.c. Curve 2, 6 mg. in 100 c.c. Curve 3, (A B D) 4 mg. of chlorophyll in 100 c.c. with 1·2 per cent carotin as an impurity. Curve 4*b* (E F H) drawn from observational readings of a test sample of chlorophyll. Curve 4*a* (E F G) the ideal curve for the same sample after comparing with the normal curve.

chlorophyll solutions in 80 per cent. methyl alcohol, containing in 100 c.c. 4 mg. and 6 mg. respectively. As Beer's law holds, the two curves are parallel. Curve 3 has been obtained with a solution of 4 mg. of chlorophyll in 100 c.c. and contains 1·2 per cent. carotin as an added impurity. Curve 4*b* is plotted from the observations on a test sample of chlorophyll. From a perusal of the region of deviation from the normal shape (Fig. 1, A B C), an ideal Curve 4*a* can be drawn and the actual change in log K caused by the carotin in this absorption region can be measured and the percentage of carotin read off from a calibration curve.

By the above procedure, it has been possible to detect carotenoid impurities in chlorophyll solutions down to a concentration of 0·05 per cent. The method of colour measurements and purity tests described here for chlorophyll solutions is applicable to other substances following Beer's law. The method has been specially useful in the laboratories in maintaining the purity of certain culture solutions by comparing their colour curves at regular intervals.

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N. K. Anantha Rao.

Institute of Agricultural Research,
Benares Hindu University,
July 25, 1940.

[1] B. N. Singh and N. K. Anantha Rao, *Plant Physiology*, April 1937.

Utility of Leaf-tip Smear Technique

Following the method of J. T. Baldwin,[1] tips of very young leaves about 1 mm. in length from the apex were selected from the youngest terminal bud, they were put in Carnoy's fixative (chloroform-acetic acid-alcohol) for about 10 minutes, were passed through a mixture of 95 per cent. alcohol and concentrated HCl in equal proportion for not more than 5 minutes, they were again dipped in Carnoy's for 5 minutes. Now the leaf-tips were put in a drop of aceto-carmine on a slide, with the help of a scalpel these leaf-tips were torn and put under a coverglass. With uniform and gentle pressure of the scalpel on the coverglass the leaf-tips were crushed uniformly and the slides were then passed over a flame three or four times, taking care not to boil the aceto-carmine, and each time a slight pressure was applied on the coverglass to spread the smear uniformly. The slides were ringed carefully and stored in a cool place in the dark for three or four days when the nuclear stains were found to have developed satisfactorily. The slides were then made permanent according to Barbara McClintock's[2] method. The smears showed all the phases of the somatic mitosis as in Fig. 1, and in some cases the chromosome-counts were possible.

The advantage of this leaf-tip-technique is that in a short time all the phases of the nuclear division can be demonstrated to beginners in

FIG. 1

Stages of mitosis under app. objective 2 mm. eye piece. × 4 6.

cell-study. It is also a time-saving process. Young leaf-tips from the terminal buds can be easily collected all the year round whereas it becomes difficult in some cases to germinate the seeds for root-tip study and some plants take a long time to flower from the vegetative stage. Moreover, flowers are not formed all the year round.

A recent instance of the utility of this method may be cited. Two specimens of *Holarrhena antidysentrica* (vern. *Kurchi*) were sent to our laboratory from the Royal Agri-Horticultural Society at Alipur. One of the specimens was suspected to be a new variety as it never set seed and usually flowered one month later than the other. On examination of the leaf-tips of both the specimens it was found that the chromosome numbers were the same in both, and thus it can be concluded that both the plants belong to the same species. It is hoped it will have great application in the field of genetics where the counting of chromosomes play such an important part.

In conclusion I beg to express my grateful thanks to Dr. S. R. Bose, Professor of Botany, for his guidance and helpful suggestions.

P. P. SEN.

Botanical Laboratory,
Carmichael Medical College,
Calcutta,
July 31, 1940.

1 Baldwin, J. T., "Chromosome from leaves," *Science*, 1939, **90**, 240.

2 McClintock, B., "A method for making aceto-carmin smears permanent," *Stain Technology*, 1929, **4**, 53.

A Sterile Mutant in Safflower (*Carthamus tinctorius* L.)

DURING the year 1938–39 selfed seeds of safflower I.P. 1 were sown in pots and the seedlings transplanted in the field unlike the usual practice of sowing the seeds directly in the field. The resulting plants, sixteen in number, were poor in growth and yielded only a few seeds each under conditions of open pollination, there being no seed setting under bag in any case. Seeds from these 16 plants were grown separately in the field during 1939–40. Early in the growth of the seedlings, one culture was marked by the presence of a few peculiar plants with thick and twisted stems. As these plants grew up, they developed other peculiarities which clearly distinguished them from the normal plants. The stems, besides being thick and twisted, were unbranched, bore thick and leathery leaves which were larger than those on the normal plants, the average length and breadth of leaves on these plants being 19·44 and 8·23 cms. and those of the normal 16·01 and 6·35 cms. respectively (Fig. 1). Each of these abnormal plants produced a single, solitary, terminal capitulum which did not open and failed to set seed. On dissection, the capitulum was found to be devoid of florets, but it merely contained white bristles

FIG. 1
Mutant plants, on either side of a normal plant (centre)

which are present in the capitulum of normal plants also along with the florets (Fig. 2).

FIG. 2
Longitudinal sections through capitula of mutant (left) and normal plant

Thus a complete suppression of the floral organs rendered the plants absolutely sterile. Attempts to induce branching in one of these plants by timely topping and also to propagate them vegetatively by cuttings failed to give the desired results. The root systems and anatomy of the stems of these abnormal and normal plants were studied. Although there was no perceptible difference in the anatomy of the stems and disposition of the roots in the soil between the two types of plants, the roots themselves appeared to be less vigorous in the case of the abnormal plants.

The actual number of the abnormal and normal plants in the segregating culture was found to be 6 and 13 respectively. In spite of the small population studied, the observed ratio of the abnormal to normal plants suggests a monohybrid segregation, the abnormal condition being recessive. It is also considered possible that all the associated characters like absence of branching, twisting of the stem, increased size of leaf and its leathery texture and sterility in the abnormal plants are determined by a single recessive gene. This recessive condition itself might have been brought about by a mutation in one of the normal allelomorphs in one of the plants grown in 1938–39, which in the following year gave the observed segregation.

Seeds of the normal plants occurring in the segregating cultures and also a portion of the seed from the original heterozygous plant will be grown in the coming year for confirming the genetics of this interesting mutant which is observed for the first time.

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August 7, 1940.

Otomycosis in a Woman caused by *Aspergillus niger* Tieghem

AFFLICTIONS of the auditory canal in human beings due to *Aspergillus niger* Tieghem (= *Sterigmatocystis niger* Tieghem, = *S. antacustica* Cramer) have been from time to time reported[1] from various parts of the world such as Japan, U.S.A., France, Brazil, Tunis, etc. The disease is said to be exceptionally prevalent in China and the temperate zones of America. Probably it is not infrequent in India but it appears from a search through the available literature that no record has been made about such cases in this country, at least during recent years. Butler and Bisby[2] in *The Fungi of India* mention *Aspergillus niger* as occurring within the seed of *Gossypium* and on soil and

in fermenting tea and rice. It has also been recorded from rot of apple[3] and as contamination of culture media in the laboratory.[4] It seems, therefore, desirable to record the occurrence of this fungus in the ear of a woman in Allahabad.

The patient, a woman of 48 years, has had four attacks during the last eight years. The second attack took place about two and a half years ago but the third attack which occurred last year has been followed by another one this year. Every time the trouble lasts for about a couple of months in the rainy season. In the beginning an itchy sensation is felt deep inside the ear in and around the tympanum. The pain reaches its climax in a week and the patient who feels her ear being blocked, hears only imperfectly. On syringing the ear with hydrogen peroxide a dirty grey mat of conidiophores and hyphæ comes out floating on the surface of the liquid. This gives great relief to the patient and hearing is restored. On the second day after this, the trouble again starts and on about the fourth day another mat of the size of a big 'kabuli' gram may be taken out. The process is repeated several times. In a fully formed mat clusters of erect black conidiophores can be seen, with the naked eye, projecting from the mass.

The fungus has been cultured several times from the original source and each time only *Aspergillus niger* developed. It is, therefore, pretty certain that only this organism is the cause of the trouble. The fungus has been grown on a variety of media such as Potato-glucose, Brown's starch, Barnes' medium, Oatmeal and malt agar. The best growth is obtained on Potato-glucose while on malt agar the growth is very feeble. The measurements as recorded from the original condition are given below:—

Diameter of the unruptured black globose head ..	.. 130–160μ
Length of the stalk (smooth walled)	.. 400–700μ
Diameter of the stalk ..	.. 12–15 μ
Diameter of the vesicle	.. 45–55 μ
Length of the primary phialides	25–35 μ
Length of the secondary phialides	8–12 μ
2–4 on each of the primary ones	
Spores	.. 3·5–4·5μ

Comparing these measurements with those given by Thom and Church[5] for this species I find that the upper limit in the size of many of the parts is exceeded by the present fungus by 2–5μ, but in view of the wide variability found in members of this species such deviations may be expected. Mention may be made about an interesting point noted in this connection. The primary phialides in the original condition measures 25–35μ in length but in culture their size decreased to 15–20μ only. The size of the other parts, however, remained the same. Experiments done in the chemical laboratory of this University showed that this strain can also convert about 90 per cent. of a solution of 3 per cent. tannic acid to gallic acid in about 6 days.

Thom and Church[5] and Dodge[6] point out that these species, probably primarily saprophytes, have found favourable conditions for growth in the cerumen of the human ear. Under ordinary conditions they are harmless beyond causing mechanical irritation but sometimes persistent ulcerations are developed. It is interesting to find that *Aspergillus niger* was first described as *Sterigmatocystis antacustica* by Cramer who obtained it from human ear! But the former name has been so much used in biochemical and other studies that it is the one now widely accepted. As the spores of *Aspergillus* are common components of dust, the disease is often ascribed to dirty habitations. This probability, however, is excluded in the case of this patient. The fact that this trouble occurs only during the rainy season shows that high humidity is an essential factor for its development.

Various antiseptics such as hydrogen peroxide, methylated spirit, hydral per chlor with or without boric acid, as advised by a doctor, have been used without much success. These reagents gave only temporary relief and the disease again appeared after a couple of days. This reappearance can be hardly ascribed to

renewed infection. Seaver[7] reports that in a similar case in his laboratory after failing with a long list of antiseptic mixtures such as carbolic acid, boric acid, mercuric chloride, etc., treatment with 50 per cent. alcohol was entirely successful but in the present case this reagent could not cure the ailment.

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Department of Botany,
University of Allahabad,
August 5, 1940.

[1] *Review of Applied Mycology*, 1926, **5**, 163; 1928, **7**, 98; 1938, **17**, 111; 1939, **18**, 179 & 313; 1940, **19**, 218.
[2] Butler and Bisby, *The Fungi of India*, 1931.
[3] Dey, P. K., and Nigam, B. S., *Indian Journ. Agric. Sci.*, 1933, **3**, 663.
[4] De Mello, F., *J. of Ind. Botany*, 1921, **1**, 158.
[5] Thom and Church, *The Aspergilli*, 1926, p. 77.
[6] Dodge, C. W., *Medical Mycology*, 1935, p. 622
[7] Seaver, F. J., *Mycologia*, 1938, **30**, 692.

Zygnema terrestris Randh. from the Kumaon Himalayas

THIS terrestrial member of the Zygnemales was originally described by the present author from moist fields lying fallow near village Mamrezpore, tahsil Tanda, district Fyzabad, U.P. This is the only terrestrial species of *Zygnema* described so far, and is readily distinguishable from species of *Zygogonium* in the absence of cytoplasmic residue from the gametangia.

It is of interest to record the wide distribution of this alga in the Kumaon Himalayas during rainy season from August to October. It was collected from Kausani and Binsar growing on sandy bridle paths and clayey rocks. The places from where this alga was collected are at an altitude of 6,000 to 7,500 feet above sea level. The filaments were freely conjugating even in August, and ripe zygospores were seen in September and October 1939.

The samples of this alga collected from the plains, as well as from Kausani and Binsar in the hills showed scalariform mode of conjugation exclusively. However the samples which were collected from near Dhakuri and Dwali from the bridle path leading to the famous Pindari glacier at an altitude of about 8,000 feet showed lateral conjugation exclusively.

In this laterally conjugating form, vegetative cells are on the average 22–24μ broad and 36–40μ long. Cross conjugation may rarely take place, but ripe spores were not observed when the alga conjugated in this manner. Zygospores are kidney-shaped, 25–28μ broad and 38–46μ long.

FIG. 1

Zygnema terrestris Randh.
A microphotograph showing 1. A vegetative filament; 2. Lateral and scalariform conjugation

Ripe zygospores were not observed in the laterally conjugating samples hence it is not possible to compare the sculpturing of the spore-wall with the samples showing scalariform conjugation. However from the size of its vegetative cells, the structure of its chloroplasts and its habitat this form resembles *Z. terrestris* Randh. and is probably its laterally conjugated form.

It is of interest to note that while this alga shows an exclusively scalariform mode of conjugation in the plains and in the hills at an

altitude below 7,000 feet above sea level, higher up it conjugates almost exclusively in a lateral fashion.

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August 6, 1940.

On *Nummulites* cf. *thalicus* Davies, from the Eocene Bed in the Pondicherry Area, S. India

IT will be remembered that one of us (L. R. Rao) recently reported[1] the discovery of an Eocene bed in the Pondicherry Cretaceous area, characterised by the occurrence of the genera, *Nummulites* and *Discocyclina* which seemed to indicate that the bed in question was of Lower Eocene (Ranikot?) age. Further studies are now being made by us on the exact nature of this foraminiferal fauna and a detailed report will be published elsewhere. We should, however, like to draw immediate attention to a small radiate *Nummulites* occurring in this bed. Fig. 1 is an equatorial section of this form which

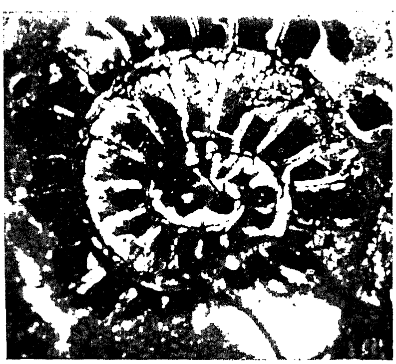

FIG. 1

Nummulites cf. *thalicus* Davies

Equatorial section. × 25. Loc.—near Pondicherry

shows (1) the paucispiral coiling of the test with chambers about three times as high as long, and (2) the septa which are straight for most of their length. Both these characters indicate that this *Nummulites* is one of the earlier and more primitive types, similar to the well-known *N. thalicus*—a typical Ranikot species in India—thus indicating that the bed containing it in Pondicherry is early Eocene in age.

It is also remarkable that the Pondicherry *Nummulites* which is a megalospheric type, shows a reticulate marginal cord which as Prof. Douville[2] has shown is characteristic of *N. planulatus* of Europe which is a microspheric type. Lt.-Col. L. M. Davies[3] has also recognised this character in *N. nuttalli* (Fig. 2)

FIG. 2

Nummulites nuttalli Davies

Part of the equatorial section. × 15. Loc.—Jhirak, Sind

(From a specimen in the G. S. I. collections)

(a form closely similar to *N. planulatus*) from N.W. India, but not in *N. thalicus*—the megalospheric equivalent of *N. nuttalli*. Thus it would appear that the Pondicherry *Nummulites* is a megalospheric form recalling many of the features of the '*nuttalli-thalicus*' group, and at the same time, shows the reticulate marginal cord, noticed so far only in the microscopic *N. nuttalli*.

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July 29, 1940.

1 *Curr. Sci.*, 1939, **8**, 166.
2 *C.R.S.S. Soc. Geol. Fr.*, 1928, p. 93.
3 *Pal. Ind.*, n.s., 1930, **15**, 68.

The Occurrence of 'Tornaria larva' at Krusadai*

THE interest of Zoologists in India in the Enteropneusta of Krusadai dates from 1922 when Dr. F. H. Gravely made known to them their occurrence at Krusadai Island. According to Narayana Rao,[1]‡ three genera and four species are recognisable in the collections made:

(i) *Chlamydothorax* (= *Ptychodera*) *krusadiensis*, (Species Novum—to be described).

(ii) *Chlamydothorax* (= *Ptychodera*) *ceylonensis*, Spengel.

(iii) *Ptychodera minuta*.

(iv) *Glandiceps hacksi*.

It is noteworthy that (*i*) and (*ii*) occur in the vicinity of Bushy Point on the Ceylon side of the Island, while (*iii*) and (*iv*) were collected from the Porites Bay and Watchman's Bay in the northern shore of the Island facing Mandapam. In the collections from the Ceylon side of the Island, *Ptychodera minuta* and *Glandiceps hacksi* have not been met with till now.§ The two species of *Chlamydothorax* (*i*) and (*ii*) occur in remarkable abundance on the Ceylon side whereas those taken in the shore facing the main-land (*iii*) and (*iv*), are rare. Subsequent attempts to collect the latter since 1934 when Ramanujam[2] obtained them, have not met with success. Though adult specimens were plentiful, no Tornaria larva could be seen in the plankton collections of the Biological Station systematically made from 1930. Is this because the development was direct in all the four species? Or was the development of these forms similar to that of *Dolichoglossus* in which it was short with a larva having a very short free swimming life? These were problems for the Zoologists to solve.

Special interest in their larvæ was aroused by a requisition for Tornaria material from Dr. G. Stiasny, of the *Rijksmuseum van Natuurlijke Historie*, Leiden, Holland, to Dr. B. Sundara Raj, Director of Fisheries, Madras, in October 1934. A cursory examination of the gonads of a few specimens of Balanoglossids from the Bushy Point in December 1934 showed somewhat ripe gonads. It was therefore assumed that the breeding season of these enteropneusta lay somewhere about the period extending from December to February. A systematic collection and examination of plankton from the vicinity of the Bushy Point was carried out in 1935–36 beginning from September 1935 and ending in March 1936. No Tornaria larva was seen in these collections. Further search for this larva was therefore given up and Dr. Stiasny was informed accordingly.

Three years later, on 3rd, 4th and 13th February 1939, in an inshore haul of plankton collected from the Kundugal channel in Lat. 9° 15′ N. and Long. 79° 13′ E. a number of Tornaria larvæ were found mixed with a few Bippinnaria larvæ. A detailed examination of these larvæ was made and it was found that all the specimens were alike and belonged to but one stage, the well-known full-grown free-swimming Tornaria larva stage (Fig. 1).

The larva has roughly the shape of a spindle. The preoral and postoral loops of the longitudinal band of cilia are well developed. The telotroch which differentiates the Tornaria larva from Bippinaria is a conspicuous feature with strong powerful cilia. The unpaired anterior cœlomic vesicle, the rudiment of the proboscis cœlomic cavity of the adult, and the two pairs of the posterior cœlomic vesicles, the rudiments of the collar cœlomic cavities and the trunk cœlomic cavities are present. There are two eyes and the apical plate but the apical tuft of cilia is absent. The last does not seem strange as this structure is absent

* Published with the permission of the Director of Fisheries, Madras.

‡ The work on the classification of the Balanoglossids of Krusadai by Prof. C. R. Narayana Rao has not yet been published.

§ This extraordinary local distribution appears to be an instance of social isolation and it is perhaps due to different ecological factors suited to the life of the different species or genera.

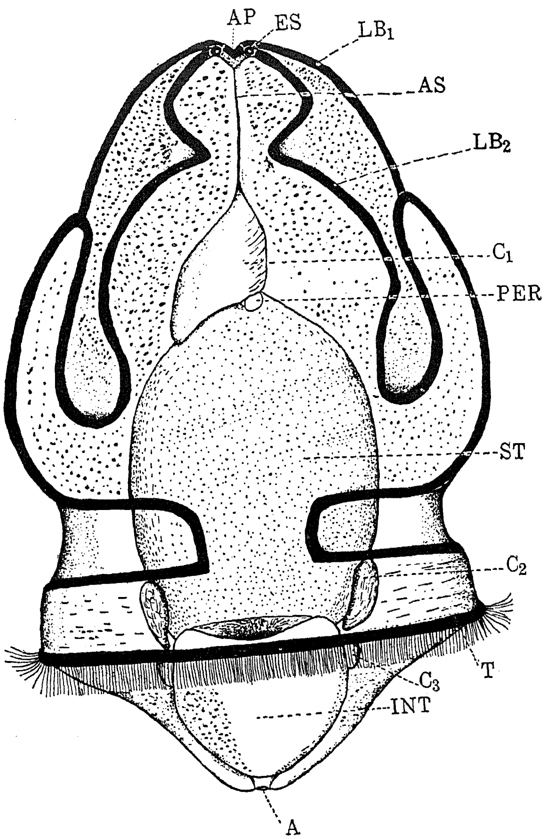

FIG. 1—'Tornaria' Krusadai

A—Anus; AP—Apical plate; AS—Apical string; C_1—Proboscis cœlom; C_2—Collar cœlom; C_3—Trunk cœlom; ES—Eye-spot; INT—Intestine; LB_1—Preoral longitudinal band of cilia; LB_2—Postoral longitudinal band of cilia; PER—Pericardium; ST—Stomach; T—Telotroch.

also in the New England Tornaria.[3] The rudiments of the future gill pouches are not seen.

Again, in the inshore plankton collected on 16th March 1939 in the same area a month later, there was a single metamorphosing Tornaria larva exhibiting elongation in its oroanal axis. It is not possible to say if this belonged to the batch of larvæ seen during February 1939. As the interval is rather long, the metamorphosis of these larvæ might have set in earlier.

As Porites Bay and Watchman's Bay adjoin Kundugal channel, one may have to seek for the parents of these larvæ in the bed of Balanoglossids there. But Bushy Point is not far off; there is a strait through which tidal currents can flow connecting the sea at Bushy Point with the Kundugal channel. One cannot, therefore, be positive that these Tornaria larvæ originated from the bed at Porites Bay and Watchman's Bay.

Last year Tornaria larvæ again occurred—(1) off Thangachimadam in Palk Bay in Lat. 9° 19′ N. and Long. 79° 14′ E., on 29th July 1939, in the off-shore plankton and (2) in the Kundugal channel on 11th August 1939 in the inshore plankton. During the current year, these larvæ appeared in the Kundugal channel on 16th and 31st January 1940 and 1st February 1940. The months in which these larvæ have occurred till now are January, February, March, July and August. This perhaps points to different breeding seasons for different species of Balanoglossids. This supposition derives support from the fact that the larvæ which appeared in January of this year are larger in size though almost at the same stage of development and different in shape from those which occurred in February of last year (Fig. 2).

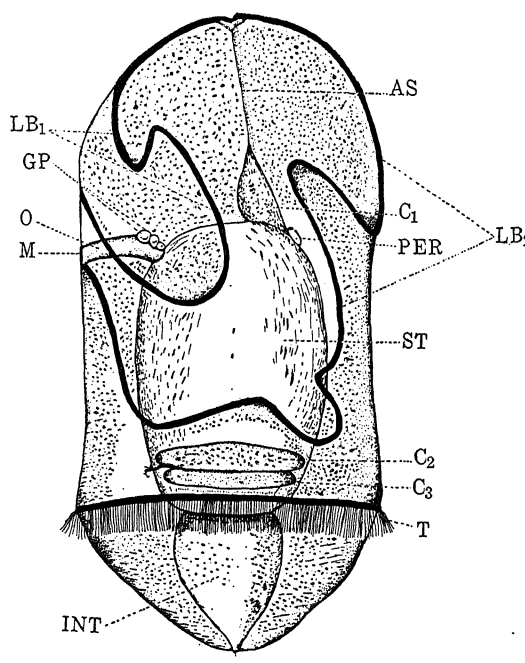

FIG. 2—'Tornaria' from the left side, Krusadai

Lettering same as in Fig. 1

GP—Gill-pouches; M—Mouth; O—Oesophagus.

The following Tornaria larvæ are known[4]:—

(a) *Tornaria dubia* from Naples, Italy.
(b) *T. mortenseni* from Misaki, Japan.
(c) *T. menoni* from Madras, India.
(d) *T. ijmai* from Misaki, Japan.
(e) *T. colmani* from Great Barrier Reef, Australia.
(f) *T. ramanujami* from Madras, India.

Of these *Tornaria menoni* and *Tornaria ramanujami* are from the sea off Madras.

A study of these Tornaria larvæ cannot be an end in itself. This is but the first step to the laborious task of referring each kind of larva to its respective parent. Such work will be rendered easy if as Bateson[5] tried and succeeded, one could attempt artificial fertilisation and rear them in Plunger jars or other Aquaria to the free-swimming Tornaria larva stage. As the number of species of the Krusadai Balanoglossids is but four, that this piece of research will meet with success at Krusadai with moderate effort cannot be doubted. When once we can distinguish the different species of the adults, and if the breeding seasons of these are ascertained by periodical examination of the gonads, it should be possible to rear artificially the Tornaria larva of each species and to distinguish their specific characters. The occurrence of the Tornaria larva indicates that development is not direct in all the species of the Krusadai Balanoglossids.

D. W. DEVANESAN.
S. VARADARAJAN.

Marine Biological Station,
Krusadai,
July 15, 1940.

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[1] Narayana Rao, *Curr. Sci.*, 1934, **3**, 70.

[2] Ramanujam, *Ibid.*, 1935, **3**, 70.

[3] Stiasny, *Uber Einige Exetische Tornarien*, 1934, 1–10.

[4] *Vide* Fig. 421, in *Invertebrate Embryology*, by E. W. MacBride, p. 577.

[5] Cf. *Text-Book of Embryology*, by E. W. MacBride, 1914, **1**.

[6] *Enteropneusta*, by Ethelwynn Trewavas, Great Barrier Reef Expedition.

On the Chromosomes of an Agamid Lizard, *Calotes versicolor*, Boulen.

RESEARCHES on the Lacertilian chromosomes date as far back as 1897 when Tellyesniczki[1] studied them in *Lacerta agilis* and found that there are 24 chromosomes in that species. Many substantial contributions to our knowledge of the chromosomes of this group, however, have been made during the past few years only, mainly by Dalcq,[2] Painter,[3] Hogben,[4] Nakamura,[5] Matthey,[6] Keenan,[7] and Kan Oguma.[8] Out of these authors the results obtained by Painter, Nakamura, Matthey and Oguma are of great theoretical importance, inasmuch as, they throw a good deal of light on the phylogeny of this group and the relationship of its species *inter se*. Matthey (1931), for example, has been able to show on the basis of the chromosome complex of Agamidæ-Iguanidæ group that it is closely allied to the group of Veranidæ-Chamæleonidæ, and therefore, can be grouped under what he calls *'le complexe iguanoide'*.

It is well known that the representatives of almost all the families of lizards are found in the Indo-Malayan region, and yet, very few of them have been examined cytologically. In fact, with the exception of the work done by one of us (J.J.A.[9]) and Bhattacharya and his collaborators[10,11] on the female gonads, very little work has been done in India on the cytology of the male gonads of this interesting group of animals. It is, therefore, hoped that this first contribution to the study of chromosome numbers in Indian lizards will stimulate interest and inquiry among workers engaged in cytological studies in this country.

Calotes, the common blood-sucker, is a lizard which is commonly found in many parts of India, Ceylon, Burma and China and belongs to the ancient family of Agamidæ. According to Smith[11] (1935, pp. 180–208) there are 23 species of this genus in the Indo-Burman region and China and they are fairly well distributed over these countries. For the purpose of the present investigation, *Calotes versicolor* was

chosen on account of its being easily available in the vicinity of Ahmedabad, Western India. Animals were dissected regularly all the year round at an interval of about 20 days and testes fixed in various fixatives like Flemming's strong and weak fluids, Champy-original, Nakamura, Allen and Bouin, PFA3, and Schaffner's fixative. By far the best results were obtained by using Allen and Bouin, PFA3 and Nakamura's fixative. Considerable difficulty was experienced in finding out the period of active cell division in the testes, as *Calotes* happens to be a cold-blooded animal and hibernates in winter months in India. A series of microscopical observations on gonads fixed in the beginning and early part of the year, however, revealed that spermatogonia begin to divide actively from about the beginning of the fourth week of February till about the first week of March. In late March and early April, animal after animal comes out from its winter quarters and moves about in search of food in the early hours of the morning. The spell of winter torporation still lingers in their eyes and they usually retire to their shady homes during the hot part of the day and pass it there quietly. When testes of such animal are examined, considerable activity is noticeable in their constituent cells. Many primary spermatogonia are found to be in an active state of division and some clear metaphase plates in which chromosomes are distinct and lie well apart are obtained. The present note is mainly based on the study of chromosomes obtained in such primary spermatogonia (Fig. 1).

FIG. 1

Calotes versicolor—Polar views of two primary spermatogonial metaphase plates in male gonads showing 34 chromosomes. × 3,600.

Curiously enough it was also observed that such division figures were not many in the testes of animals that were opened during daytime; whereas, they were comparatively many in the material fixed at night between 11 p.m. and 3 a.m. Possibly, light seems to affect the condition of the sex cells in lizards also, as has been found to be the case in the gonads of birds and mammals.

Fig. 1 illustrates two metaphase plates observed in two primary spermatogonia. From these and the examination of some other plates it was determined that the chromosomal complex in the gonads of male *Calotes versicolor* consists of the following:—

(1) 12 large V-, U- or J-shaped chromosomes with atelomitic attachment, arranged in a ring at the periphery of the spindle,

(2) 6 medium-sized slightly elongated chromosomes with telomitic attachment, spread peripherally inside the ring of 12 V-shaped chromosomes, and

(3) 16 small dot-like microsomes, *m*-chromosomes, distributed in the central portion of the metaphase plate.

In all there are, thus, 34 chromosomes in male *Calotes versicolor*.

That there should be 12 V-shaped chromosomes in this complement also is a striking confirmation of Matthey's (1931) predictions; because, according to him, the whole '*le complexe iguanoide*' comprising six families of Autosauria, *viz.*, Anguidæ, Xantusidæ, Veranidæ, Helodermatidæ, Iguanidæ, and Agamidæ, is characterised by a peripheral ring of 12 V-shaped chromosomes with a varying number of microsomes in the centre of the spindle; and this has been found to be quite true in all the species of Agamidæ in which the chromosomes have been so far recorded. Thus, in *Agama stellio*, and *Uromastrix hardwickii* studied by Matthey (1931), and in *Japalura swinhonis* studied by Matthey (1929) and Nakamura (1931), there are 36, 36, and 46 chromosomes respectively out of which 12 are V-shaped. In *Calotes* also there are 12 V-shaped chromosomes, but the number of microsomes

in it is smaller than that observed in other Agamid lizards. This may be due to its primitive condition in the family. The only other lizard in which the same number of this category of chromosomes has been recorded is *Holbrookia texana* studied by Painter (1921); but that lizard does not belong to Agamidæ. According to Painter (1921), there are 12 macrosomes and 22 microsomes in that lizard, as against 12 macrosomes, 6 medium-sized chromosomes, and 16 microsomes in *Calotes versicolor*. The chromosomal constitution of the latter, therefore, differs much from that of the former.

Another important point that emerges from the present study of the chromosomes of male *Calotes versicolor* is in respect of its sex-mechanism. As the number of chromosomes in male *Calotes* is *even*, it is very likely that the chromosome complex in it may be of XX-type, as has been observed in a Japanese lizard, *Lacerta vivipara*, by Kan Oguma (1934).

Investigations illustrating these points and several others have been carried out in this laboratory and would be published elsewhere.

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M.R. Science Institute,
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July 25, 1940.

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Sagitta bedoti Béraneck in Madras Plankton

Very recently I examined the *Sagitta* in the Plankton collection in the laboratory and was surprised to find that one of the commonest forms, *S. bedoti*, has not been recorded from Madras up till now. In 1933 John[1] recorded five species, *viz.*, *S. enflata*, *S. gardineri*, *S. neglecta*, *S. tenuis* and *S. robusta* and mentioned in a later paper[2] the occurrence of two more species, *S. hispida* and *S. planktonis*. From an examination I find only the three species *S. enflata*, *S. bedoti* and *S. tenuis* occurring commonly in the Plankton. Out of the seven species described by John, *S. gardineri* at least seems to be a synonym of *S. enflata* (Fowler,[3] Michael,[4] Tokioka[5]).

Sagitta bedoti Béraneck occurs throughout the year, the number varying with the seasons. Following Michael[6] I give below a table giving the measurements of the various diagnostic characters, from 20 specimens.

It appears from a comparison of the above with the description and measurements of *S. robusta* given by John[1] that what he identified as *S. robusta* is *S. bedoti*. Michael[4] considers *S. robusta* Doncaster as identical with *S. hispida* Conant and gives for comparison a table of measurements of the two species. A perusal of the table shows that in *S. robusta* the posterior fins are longer than the anterior. Fowler[3] who redescribed *S. robusta* states that the posterior fins are longer and uses this character to distinguish *S. robusta* from *S. ferox*. On the other hand in John's[1] description it is stated (p. 5) that the anterior fins are longer, and the measurements given are 27–29 per cent. for the anterior fin and 18–20 per cent. for the posterior fin. Apparently what John had before him was not *S. robusta* but *S. bedoti*.

The occurrence of *S. bedoti* in Madras Plankton is not surprising since it seems to be characteristic of the upper epi-plankton of the Indo-Pacific region. It has been recorded from the Natal Coast by the Gauss Expedition, from the Bombay Harbour by Lele and Gae,[7] from the

TABLE

Number	Length in Millimetres	Width	Length of Tail	Tail to Ventral ganglion	Anterior Fin: To ventral Ganglion	Anterior Fin: To posterior fin	Anterior Fin: Length	Anterior Fin: Width	Posterior Fin: Length	Posterior Fin: Width	Posterior Fin: % in front of tail septum	No. of Anterior Teeth	No. of Posterior Teeth	No. of Prehensile Spines
1	4·31	5	26·	66	Nil	6	22	3	21	4	40	6 6	10 10	7 7
2	5·17	5	26·6	66·6	1·6	6·6	21·6	3·3	20	3·3	41·7	7 8	12 12	8 8
3	7·07	6·1	27·7	?	?	4·8	26·8	3·6	24·4	4·8	40	7 7	14 14	7 7
4	7·15	7·2	27·7	69·7	Nil	6	22·9	2·9	19·2	5·4	37·5	8 9	12 14	7 8
5	7·24	5·9	26·2	?	?	4·8	25	3·6	22·6	4·8	42·1	8 8	12 12	7 8
6	7·58	5·6	26·1	70·4	Nil	5·7	27·3	3·4	21·6	4·5	42·1	6 7	12 12	8 8
7	8·01	5·4	26·8	69·8	2·1	6·4	24·7	3·7	21·5	4·3	42	6 7	12 11	7 7
8	8·01	5·3	25·8	69·9	2·1	6·4	26·8	3·2	22·6	4·3	47·6	6 7	14 14	7 8
9	8·01	6·4	25·8	?	?	7·5	26·9	3·2	20·4	4·3	42·1	8 8	12 12	7 7
10	8·19	6·3	28·4	70·5	Nil	6·3	27·1	3·2	23·2	4·2	40·9	6 6	12 12	7 8
11	8·62	5·2	27·	70·	2·5	11	23	2·5	17	3·3	35·3	6 6	13 12	7 7
12	8·88	5·6	25·2	70·8	Nil	5·8	23·3	2·8	21·3	3·3	45·4	6 8	15 16	7 7
13	8·96	5·2	24·7	70·4	Nil	5·7	26·6	2·8	20·9	3·8	45·4	9 9	17 17	7 7
14	8·96	5·8	25·	69·2	Nil	8·6	26·9	2·9	18·2	3·8	42·1	6 7	13 13	6 6
15	9·05	6·7	23·1	66·5	Nil	6·2	27·9	3·8	21·1	3·8	45·5	7 8	15 16	7 7
16	9·22	4·7	26·1	70·0	2·8	8·4	24·3	2·8	20·5	4·2	40·9	8 8	13 14	8 9
17	9·48	5·5	27·3	70·9	2·3	8·2	26·4	3·2	19·1	3·6	42·8	9 10	15 16	7 7
18	9·73	5·3	25·7	69·0	Nil	6·2	26·5	2·7	23	2·9	45·1	9 10	14 16	7 7
19	11·03	4·7	25·	69·6	Nil	6·2	26·6	2·3	21·1	3·1	44·4	10 10	14 14	7 7
20	11·10	5·4	27·7	73·1	Nil	7·7	27·7	3·1	20·7	3·8	40·9	10 10	16 16	7 7

Maldive and Laccadive Archipelago (as *S. polyodon*) by Doncaster,[8] from the Malay Archipelago by Béraneck,[9] from the Siboga region by Fowler,[3] from the Philippine waters by Michael,[6] from Misaki Harbour (as *S. bipunctata*) by Aida,[10] from Sagami and Suruga bays of Japan by Tokioka,[5] and from Australia by Ritter-Zahony.[11]

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July 30, 1940.

* All measurements made in per cent. of total length of animal.

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Indian Honey

THE genuineness of Indian honey is not to be assessed by the uncritical application of Western standards.

It cannot be too often pointed out that while the determination of analytical results in the case of foodstuffs often requires a high degree of experimental skill, the interpretation of the results may be a far more delicate matter, demanding experience, judgment and caution.

A suspected sample of honey was examined by us with the following result: Water 22 per cent.; Ash, 0·2 per cent. in which sulphate was present, chloride absent; 'Specific' rotation of the total solids, $-11°$, changing to $-15°$ on inversion with acid.

Now the average values for European and

American honey are: Water, 20 per cent.; Ash, 0·25 per cent., free from sulphate and chloride; 'Specific' rotation, +3° to −3°, changing little on inversion. If the ash is high and contains sulphate, adulteration with invert sugar is indicated; if it contains chloride adulteration with molasses may be suspected. A high positive rotation suggests sucrose or 'starch sugar' (crude glucose), negative, invert sugar.

If we apply these considerations to the above analytical results, we see that the water and ash are normal, and the change of rotation (representing about 5 per cent. sucrose) is reasonable; but the high negative rotation, −11° inverting to −15°, clearly indicates heavy adulteration with invert sugar, provided only it is known that the honey had not crystallised before being strained from the comb, since dextrose crystallises first leaving the residual syrup lævorotatory.

Before making a report, however, we secured some authentic samples in the comb. Two bees are common here, a little one *Apis Indica* and a big one *Apis Dorsata*, var. *Nigri Pennis*. The honey of both these bees gave results so like those obtained for the suspected sample as to fully vindicate its genuineness, as will be seen from the following table:

	Western average	Suspected sample	Big Bees' honey	Little Bees' honey
Water %	20	22	16·5	16·3
Ash %	0·25	0·20 sulph. +	0·01 sulph. —	0·27 sulph. +
Rotation	+3°/−3°	— 11°	— 10°·6	— 9°·6
After invn.	,,	— 15°	— 14°	— 10°·2

Our samples were taken near Agra in April when the bees' chief source of supply was probably the flowers of the *nim* tree. At other times of the year, the results might be very different; English honey being essentially 'summer honey' is probably more uniform. It would be interesting to know whether honey from other parts of India is strongly lævorotatory, a fact which is not easy to account for.

R. D. Gupta.
H. Krall.

Chemistry Department,
Agra College,
Agra,
June 28, 1940.

A Correction

I beg to point cut some fundamental mistakes in the article on "A Proposed Classification of the Nasal Elevation Index" by Mr. Sasanka Sekhar Sarkar of Bose Institute in the *Journal of the Indian Anthropological Institute,* Vol. I, Nos. 1 and 2, 1938, published in 1939.

In page 63 the writer has used the term nasal length (*n* to *ns*) which has long been discarded by Martin and others. He will also find that even in the Monaco Agreement 1906[1] (to which he has given reference) this is termed as nasal height. Moreover the nasal length and the nasal height have been distinguished by Martin.[2] In the case of nasal length, the landmarks are nasion to prcnasion (Martin, p. 189) and in the case of nasal height it will be (in the case of living) nasion to subnasale (Martin, p. 188). The writer has also mentioned that the nasal length (?) is measured from nasion to nasospinale in the living. This is absolutely incorrect. In the case of living subjects the nasospinale point cannot be located without piercing through the skin to find out the bony ridge. This is practically impossible. The landmarks in the case of living will be nasion to subnasale or the nasal septum where it joins the upper lip.

J. K. Bose.

Department of Anthropology,
Calcutta University,
Calcutta,
July 31, 1940.

[1] Hardlicka, Ales, *Anthropometry*, 1920, p. 22.

[2] Martin, R., *Lehrbuch der Anthropologie*, I, Jena, 1928, pp. 188, 189.

REVIEWS

Essays in Polynesian Ethnology. By Robert W. Williamson. Edited by Ralph Paddington. (Cambridge University Press), 1939. Pp. xlii + 373. Price 25*sh.* net.

This book consists of essays, articles and memoirs on Polynesian cultural history, left unpublished by the late Robert Williamson who was a reputed authority on the social and political systems of Central Polynesia. In bringing the manuscripts together Dr. Paddington has reviewed all the valuable material which has appeared since Williamson's death. This book is not a collation of ethnographic evidence of the religion, social organisation and customs of Polynesian races, but forms an illuminating and penetrating analysis of the history and origins of the culture, general migration and subsequent inter-island movements of Polynesians. The manuscripts left behind by Williamson deal mainly with the problems of migration and inter-island movements, but no attempt was made to discuss the more general problems, namely what historical inferences could be drawn from the existing Polynesian material. In the second part of the present book Dr. Paddington has given a review of the position of historical ethnology in Polynesia. Such a review must necessarily enter into the controversy between the historical and functional schools, which is a logical development from the earlier conflict between parallelism or evolutionism on the one hand and diffusionism on the other. The Preface forms an admirable critical analysis of the divergence of opinion between functionalists and historians on the social and political developments, religious faiths, superstitious customs and beliefs and practices among the primitive races.

The first part of the book consists of five chapters dealing with "Warfare in Central Polynesia", "Kava in Samoa and Tonga", "Kava in other Polynesian Islands", "The Arioi" and "Sex, Courtship and Infanticide". We may state at once that the causes of war among the savage tribes are not different from those which provoke international hostilities among civilized communities, and wars are declared by the war councils of the primitive people after the fashion of the democratic political cabinets. In Tahiti, Samoa and Tonga islands practically all the male inhabitants capable of handling a club were conscripted for war service, and the only members who were exempted were women, children, old and diseased men, priests and "Spiritual Kings". However, the bolder spirits among women acted as camp followers, cooks, nurses and scouts and it was not uncommon for women of the opposing forces (as in Penrhyn island) to attack each other, tear each other's hair and garments—only too familiar with all civilised women—to be displayed as trophies. Lest the enemy clutch a handful of such prizes, they took the precaution to reduce them to the minimum. The religious observances associated with warfare included the taking into battle of images or emblems of Gods, to whom particularly human sacrifices were offered, apart from the terrible feast awaiting the termination of the battle; the priests singing prayers and hymns in praise of the Deity; and strange rituals connected with the sacred canoes of Oro and other Gods. While the kings and chiefs marshalled, armed and reviewed the warriors, the priests were unremitting in their prayers to the Gods.

The victors in the battle engaged themselves in another ceremony in connection with division of the spoils and the appropriation of the enemy's country; it was regarded as a ceremony of devoting the slain to the Gods, praying "Let the God of War return to the World of Night, Let Ru, the God of Peace preside in the World of Light". Perhaps the "new world order" may be born in the Island of Samoa, the people of which have successfully and satisfactorily solved many of the human problems which perplex civilization. In this as in the neighbouring islands:

> "The meeting of two hostile armies was the occasion for preliminary acts of mutual courtesy. Each presented to the other a piece of Kava, 'this is for you chiefs and warriors to drink', these offerings being made and accepted with the most polite words. Then would perhaps follow a discussion as to whether they should begin hostilities at once or postpone them, say, till next day; this discussion might last for some time, the leaders of each army modestly disclaiming the propriety of discussing such matters in the presence of such chiefs and warriors as their opponents, and wishing to avoid the appearance of an attitude of dictation. If for

some reason, say, the approach of night, fighting, or "trampling the grass," as it is called, was postponed till the next day, the two opposing armies would lie through the night quite close to each other, without the slightest fear of treachery on either side. Apparently a custom of a somewhat similar kind prevailed in Tongareva."

The peace ceremonies were equally endearing, the mortal enemies embraced, kissed each other and offered feasts and prayers.

The custom of drinking Kava, an infusion of the roots of the plant *Piper methysticum*, widely practised throughout Central Polynesia, was attended by an extremely complicated and elaborate ceremony. The Arioi organisation of professional entertainers was one of the most important institutions of Society Island culture. It has, however, been suppressed under missionary influence. Chapter IV is devoted to a detailed consideration of the magico-religious phases of the society and the bearing of their more general aspects in the historical connection between the Arioi and the secret societies of Melanesia. Judged by the evidence regarding the customs and practices relating to sex and courtship, the Polynesian usages seem to have resolved themselves to simplicity itself. When man first conceived the idea of exclusive possession—no matter what the object of his possession was—he also laid the foundation of all moral and penal codes which are non-existent in human societies where sex and property are not regarded as sinful or as things to be exclusively possessed. The progress of religion, culture and civilization, in the ultimate analysis, is the hardening of injunctions and prohibitions, though it is inconceivable how one part of the human anatomy could have become more shameful than another or why the bounties of nature should be monopolised. The thing started in the doctrine "Might is Right", and the same principle masquerades under the theory "Possession is nine points in Law", the tenth being annexed in the judicial courts.

Throughout the Polynesian area there is a general cultural homogeneity of language, religion, technology and social organisation combined with striking differences between the various island groups. The sixth chapter deals with the most general problems of historical ethnology in Polynesia, respecting the stability and change in the culture of the people.

Part II forms an important study in assessing the present position of historical researches in Polynesia, with special reference to certain views propounded since Williamson's death. It deals with the recent theories of Polynesian origins, having a bearing on the controversy between the historical and functional schools, which is undoubtedly the most important issue in anthropological study to-day.

The book forms a notable contribution to our knowledge of the Polynesian races. The problems are treated in a critical and scholarly style, and in its comprehensiveness the book ably maintains the traditional prestige of research and study intimately attaching to the Cambridge University Publications. There is an embarrassing wealth of bibliography, a map and an exhaustive index. The illustrations, though few, are carefully selected and beautifully reproduced.

Animal Behaviour (Impulse, Intelligence, Instinct). By Dr. Johann A. Loeser. Illustrated by Erna Piuner. (Macmillan & Co., Ltd., London), 1940. Pp. x + 178. Price 10*sh.* 6*d.* net.

We have been taught by the professors of religion and theology to believe that animals lower in scale than man are not endowed with powers of reason, judgment and will, which are, however, the peculiar attributes of "the image of God". That school of biological thinkers who advocate the mechanistic conception of life simply regard animals and man as automatons. The former view is as flattering as the latter is partial and inadequate. The arguments of the book form a refutation of these theories.

Dr. Loeser, formerly of the University of Berlin, was a keen observer of animal behaviour and when, in 1938, he arrived in England as a political refugee, he was persuaded to publish his rather revolutionary views which were then unknown to the British public. The untimely death of the author deprived the book of the benefit of revision of certain important sections of it, which he had intended to do in the light of the new investigations. If we accept the principle of the animal origin of man, then it follows that all his mental attributes and faculties must have animal counterparts, and the difference can only be quantitative and not qualitative. The general needs and

purposes of life in the functional or biological sphere cannot extend beyond "Avoidance of pain, need of food, impulses leading to propagation, formation of herds and states and migrations". In every one of these departments of activity, the behaviour of animals, including the lowest organisms, seems purposive, directed to the achieving of a definite object, and the processes involved appear as complicated and intelligent as those characterising the higher animals. In other words, all animals act according to the psychological laws, limited by their organisation and governing their own nature, and this power of adjustment of their actions in conformity with the varying conditions of environment, which we may call "free will" can not be fundamentally different from the "free will" of man. It must be remembered that the faculties we call "feeling, reason, judgment and will" depend for their manifestation upon and are limited by the evolutionary phase of the physical organisation of animals including man, and there can be only one law for them all. Reactions to impulses must naturally vary where the animal organisation presents a bewildering variety of modifications, and it is almost inconceivable how an absolute and invariable connection can exist between reactions and impulses. The ideas of instinct and reflex actions, derived from the theory of preformation and mechanistic concepts will be found inconclusive and unsatisfactory. In the fourteen chapters of which the book consists, the author has endeavoured to demonstrate in general outline that organic acts caused by simple sensations are based on the principle of free, intelligent action, and to prove that the assumption of a preformed mechanism, under the name of impulse, instinct or by any other term, which functions with unconscious purposiveness and pursues and attains a specific biological end with automatic certainty, has in no case been necessary or tenable.

The book provides very stimulating reading, and within its short compass is brought together a mass of observations, appropriately arranged under the different categories of animal behaviour, with inferences and deductions which must inevitably follow from their dispassionate study. Those who have not passed through the discipline of science, will find in this little book both pleasure and profit.

Theory of Probability. By Harold Jeffreys. (Oxford University Press, Oxford), 1939. Pp. 380. Price 21*sh.*

The idea of the likelihood of an event has always fascinated the common man as well as the scientist. From application to games of chance the theory has gone on to conquer wider and more important fields, and at present it reigns supreme in the realms of natural and social sciences. The materialism and determinism of the nineteenth century have given place to an indeterminism which ought to have been obvious to any one after the work of Gauss on the Theory of Errors, but which had to wait for a hundred years to be introduced by Bohr and Heisenberg as a fundamental result in science. The consequence is that a law of nature is no longer believed to be a cut and dried rule according to which events take place, but is assumed to be merely a statement of probabilities and uncertainties.

Since Laplace gave the first analytical theory of probability, many eminent workers have tried to put forward a self-consistent scheme. During the last half-century such efforts have been made by Poincare, Borel, R. Mises, F. P. Ramsey and others. Professor Borels' school in Paris is entirely devoted to the development of the theory of probability and its applications and a number of volumes in Borels' collection have already been published.

Dr. Jeffreys' book is a welcome addition to the literature on the subject, and presents the theory of probability on a systematic and well-conceived plan which has been admirably executed. The main object of the book is to provide a method of drawing inferences from observational data which will be self-consistent and which can be used in practice. The author refutes the thesis that induction can be reduced to deduction and claims that the former is more general than the latter. The principles enunciated by him rule out any definition of probability in terms of infinite sets of possible observations, for he remarks that an infinite number of observations cannot be made. The fundamental idea is not simply the probability of a proposition p, but the probability of p on data q, thus making probability a function of two arguments instead of one as done hitherto. The notation throughout the book is that of Whitehead and Russell's *Principia Mathematica*. The number associated with the probability

is written in Dirac's bracket notation used in quantum mechanics.

After laying down the general rules for the construction of a consistent theory of induction, the author deals with direct probabilities in the second chapter, giving a detailed account of sampling, sampling with replacement and multiple sampling. The normal law of error, the Pearson laws and the negative binomial law are derived. The characteristic function and its uses in the t-, and z-distributions are calculated.

The third chapter deals with estimation problems, and the unknown parameters are evaluated in several important cases. The Bayes-Laplace theory is extended to the sampling of a finite population. The fundamental result in this section is the principle that "any clearly stated law has a finite prior probability and therefore an appreciable posterior probability until there is a definite evidence against it". The method of least squares is considered as an extension of the estimation problem.

Approximate methods for the estimation of maximum likelihood and successive approximations for the least square equations are given in the fourth chapter. Simplifications are introduced by the use of expectations. It is shown in detail how the observed data can be smoothed out in our quest to find the unknown law.

Then there are two lengthy chapters on significance tests. This is perhaps the most important part of the book from the point of view of the statisticians. The questions of simple contingency, comparison of samples, consistency tests, comparison of correlations, independence tests, deduction as an approximation, etc., are thrashed out in an adequate manner, and the work of Fisher and other workers is discussed in great detail.

In the seventh chapter on Frequency Definitions and Direct Methods, the three definitions of probability, *viz.*, the classical definition given by De Moivre, the Venn-limit definition adopted by R. Mises and Fisher's hypothetical-infinite-population definition have been analysed and their various advantages and defects pointed out, showing at the same time that, contrary to current belief, the three definitions are not equivalent. The author himself claims to be in general agreement with Professor Fisher.

The book abounds with discussions on scientific method and inference, determinism and free-will, observables in quantum theory and relativity, and on many such topics of importance and interest. It has all the qualities of lucidity and terseness characteristic of Dr. Jeffreys' writings. It has been published in the *International Series of Monographs* on Physics and its printing and get-up are of the high standard associated with these volumes. M. R. SIDDIQI.

Properties of Ordinary Water-Substance. By N. Ernest Dorsey. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1940. Pp. 673. Price $15·00.

Water is a remarkable substance, not merely from the standpoint of its abundance in Nature, but also due to its abnormal physical and chemical properties. It plays a predominant role in biological and physical processes and is indispensable for sustenance of all kinds of terrestrial life. It is noteworthy that no proper treatise on such an important substance was till recently available in English literature. Mellor has, in his *Treatise on Inorganic Chemistry*, given a comprehensive account of water, but due to the limitations of the scope of his work, the information could not be complete.

This void in scientific literature is filled, with credit, by the book, *Properties of Ordinary Water-Substance* by N. E. Dorsey, which is sure to be an exceedingly useful addition to both scientific and popular libraries. The term "Ordinary Water-Substance" sounds queer and the author could have had it as simple plain "water" without sacrificing the implication that it includes this substance in all its phases.

This compilation deals with all physical aspects of water, comprising within its scope profuse numerical data preceded by explanatory notes which make the work complete in itself. The discussions accompanying many items are unbiassed, and the author has given all viewpoints. Full use of the facilities available at the *National Bureau of Standards* was made in presenting a complete bibliography on work done on every aspect of water. It is difficult to find any omission in respect of either references or data regarding any property of water. The reader may feel disappointed at the omission of the chemical and solvent properties of water, but the treatise being comprehensive even as it is, the author has done well in excluding these aspects from the purview of

this work. There are, however, a few items whose inclusion would have made the book more interesting. For example, a lay reader may appreciate an account, with the probable explanation, of the difference in the colours of different seas.

The explanatory notes and formulas in many places are brief and to the point, but one cannot fail to notice the partiality of the author for Debye's theory of Dipoles which he has developed in detail. Though it is not possible to minimise the importance of this theory, a mere mention of the final formula would have made this portion of the subject consistent with others where the formulas only are given.

The general get-up and presentation of matter are up to the standard of the *American Chemical Society Monographs*. But on going through the book, one cannot fail to notice the mixing up of running matter and tables, and there are not a few instances where one finds difficulty in locating the continuation of the text. The publishers would have done well by presenting the running matter and tables in different types.

The book is highly commendable for both physicists and chemists and no library can be complete without a copy of this.

I. RAMAKRISHNA RAO.

Plant Physiology. By Bernard S. Meyer and Donald B. Anderson. (Chapman & Hall, Ltd., London), 1940. Pp. 696. Price 24*sh*.

Meyer and Anderson have rendered a great service to students of plant sciences in bringing out the text-book on plant physiology for colleges and Universities. The need for a suitable text on the subject was keenly felt by all concerned as the available books on the subject had either become out-of-date or did not fully meet the requirements of undergraduates. The absence of a suitable text-book was a great handicap both to students and teachers and consequently students in general could not keep abreast of modern developments in plant physiology.

During the last few years highly specialised monographs dealing with particular topics such as photosynthesis, transpiration, respiration and permeability have been published by authorities but they were meant more for research workers than for students taking a degree course in Botany. Other books on plant physiology that have been published in recent years were found to be unbalanced in their contents. Many important aspects were completely omitted while some others were dealt with in greater detail than were required for a text-book. Personal opinions and predilections had also found their way in the text.

The publication of the text-book under review should, therefore, be welcome as it puts in the hands of students a concise and up-to-date information on all aspects of plant physiology. Its contents are well balanced and every important topic is included while superfluous details are omitted. In short it is a text-book in the true sense of the word.

Recent discoveries and concepts are well summarised and chapters on diffusion, permeability, physical properties of sols and gels, and growth hormones are well written. The book will thus prove a useful guide to teachers and a great boon to students.

A perusal of the book will at once bring home the fact, not yet adequately appreciated, that a sound knowledge of the principles of chemistry and physics is a prerequisite to the study of modern plant physiology. There is no aspect of plant physiology which can be understood in the absence of that knowledge and this book amply supports this view. Those who do not possess the knowledge of these sister-sciences will find many chapters of the book stiff reading.

A bibliography of relevant books and original papers is appended to each chapter for collateral reading. Useful guidance is, therefore, furnished for obtaining more detailed information on the subject-matter of each chapter.

There can be no doubt that this book will soon be appreciated by all who read or teach plant physiology and will find a place amongst the prescribed or recommended books in all our Universities. It is also expected that it will remain long as a standard book on this branch of plant sciences.

It is a book that should prove of value to those engaged in agricultural research. In order to find out improved methods of cultivating the crop plants, and of increasing their yields, an understanding of the inner working of the plant is essential and this book gives that insight.

R. H. DASTUR.

Biology of the Vertebrates: A Comparative Study of Man and His Animal Allies. By Herbert Eugene Walter. Revised Edition. (Macmillan & Company, Ltd., London), 1939. Pp. 882. Price 21*sh.*

Prof. Walter is a well-known author and his books are usually well written and analytical, and command a good sale. It is not surprising, therefore, that the first edition of this book published in 1928 has within ten years gone through eleven editions. Prof. Walter has now brought out a revised edition, as he felt the time has come for drastic changes and the addition of new material. The present Edition consists of 882 pages, 93 pages more than the last and has 737 illustrations including 80 new ones. The entire text has been rewritten. The book consists of three parts. Part one forms the background or introduction for the other two and deals with Taxonomy, Chorology, Palæontology, Anthropology, Cytology, Histology, Embryology, and Pathology—practically all important aspects of Zoology. Parts 2 and 3 relate to Physiology, the mechanism of metabolism and reproduction being treated in Part 2 while in Part 3, the mechanism of motion and sensation is dealt with.

Prof. Walter is a racy and effective writer and the book abounds in interesting and useful information which will interest even a lay-reader. The book may, however, be a little puzzling to Indian students as the author throughout adopts American spelling —fetus, travelers, esophagus, marvelous, feces, etc. He evidently disapproves of systematists who take a malevolent delight in changing familiar names and the yellow-fever mosquito still goes in this book with its old familiar name of *Stegomyia fasciata.* The posture of *Kiwi* in Fig. 47 appears unnatural.

The book will be found highly useful by all students of Zoology, though primarily written for the pre-medical student in America. The book contains a fund of information, well put in proper context. The revised edition will undoubtedly be as popular and call for frequent reprintings as the first edition.

S. G. M. R.

Guide to the Study of the Anatomy of the Shark, the Necturus and the Cat. By Samuel Eddy, Clarence P. Oliver and John P. Turner. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1939. Pp. vii + 100. Price 11*sh.* net.

The book is intended to serve as a guide, in practical work, to students of comparative vertebrate anatomy at the University of Minnesota. The course is designed to be gone through in one quarter. The three forms, the spiny dogfish shark (*Squalus acanthias*), Necturus, and the Cat are chosen as they represent important stages in vertebrate development. It would have been well, in the reviewer's opinion, if the gap between Necturus and the Cat had been bridged over by the addition of another type — a reptile. The authors deal with the anatomy of the dogfish shark fairly exhaustively. The description follows, more or less, the various steps adopted by the student in his actual dissection with the result that descriptions of some of the systems are somewhat interchanged. Thus in dealing with the anatomy of the shark the authors end with the description of the skull instead of giving it a more forward position. There is a small section on the skull of the cod fish, though there is no mention of this in the title of the book. This is introduced as a preparation for the study of the more complicated skull of the higher vertebrates. The anatomy of Necturus is fully dealt with. The method of treatment adopted is the same as for shark. In dealing with Necturus and the Cat the authors have given a partial description of some of the outstanding muscles in order to give the student some experience in the dissection of muscles. Throughout the book the authors have adopted a perfectly simple and direct style best suited for the beginner in his study of vertebrate comparative anatomy. Unnecessary details are carefully avoided. The few figures given are simple and clear cut.

A book of this kind, however, should be illustrated with a larger number of diagrams. There are just 15 diagrams for the 3 types dealt with, the result being that several important organ systems go without illustrations. There is a good index.

R. Gopala Aiyar.

Laboratory Directions in General Zoology. By W. C. Curtis and M. J. Guthrie. (John Wiley & Sons, New York; Chapman & Hall, London), 1939. Third Edition. Pp. 195. Price 9*sh. net.*

This edition has been fully revised in the light of the authors' experience in teaching. There are two important additions, a chapter on vertebrate development and another on Heredity and Variation. There is a substantial increase in the number of figures.

The method adopted in this book has been evolved after forty years of teaching in the University of Missouri. To begin with, the student is made to study in great detail the anatomy and physiology of the frog and further suitable directions are given to him to extend to other animals and to see for himself the principles recognised in the frog. This method helps the student to have a first-hand knowledge of the animals he is studying and enables him to understand thoroughly what he reads in text-books and learns in a lecture class. There are also chapters on general principles of zoology. In the Appendix are given directions for the preparation and the use of common stains and reagents and instructions for physiological and other miscellaneous laboratory experiments. The object of the authors has been to impress on the mind of the student the zoological facts and principles by such methods as are most effective rather than to give the stereotyped survey of the animal types. This book fulfils the requirements of an excellent introductory course in zoology. The method followed in this book can be adopted with great profit in the Indian Universities.

A. S. R.

A Laboratory Manual of Vertebrate Embryology. By F. B. Adamstone and W. Shumway. (John Wiley & Sons, New York; Chapman & Hall, London), 1939, Pp. 87. Price 7/6.

This book deals with the anatomy of selected embryos of the Frog, Chick and Pig. The laboratory course consists of the study of the serial sections and injected whole mounts of important stages of embryos. Directions and drawings of sections are given with the help of which the student is enabled to identify and study the different parts of the embryo. Spaces are provided in the manual for recording the observations of the student and making sketches of representative sections and further he is directed to label all unnamed structures in the text-figures. The directions are clear and instructive. This course enables the student to grasp the fundamentals of vertebrate embryology. We have great pleasure in recommending this book to every student of Zoology.

A. S. R.

BURIED EMPIRES

Buried Empires: The Earliest Civilizations of the Middle East. By Patrick Carleton. (Edward Arnold & Co., London), 1939. Pp. 290. Price 10*s*. 6*d*.

IT may be considered a form of prejudice, but I always feel that I am "put off" a book when I find that the author is guilty of inaccuracy in foreign words, spelling of names and the like.

I do not think I have ever met a book, purported to be a scientific treatise, so full of systematic mis-spellings. Almost every single Indian word is wrongly spelt; and, what is more, there is the affectation of preciseness by putting on Indian vowels diacritic accents, invariably on the wrong letter. Here are a few cases of Indian words misspelt: Shīva (instead of Shiva); Vāruna (instead of Varuna); Āgni (instead of Agni); Sūryā (instead of Sūrya).

He would write Panjāb (quite correct, but never used in modern geographical terms) and even Karāchi (more correctly: Karāchī, but again length-marks unnecessary in modern names); but on the other hand he will write Fars and Karman (instead of Fārs and Kermān). He writes Khūzistan (correct would be Khūzistān) and Kurdistan (instead of Kurdistān); and he writes Baghdād (everyone writes the word without accent; but if you want to show the length-marks, you *must* write Bāghdād, with accents on both vowels). He ought to know, for he has been in the East and did digging there; presumably, he has Arabic, without which he could not talk to his labourers. But Mr. Carleton was Woolley's assistant, as the book-jacket declares; yet Mr. Carleton refers to his own boss every time as Sir Charles Woolley. He

might have discovered that the name was Sir Leonard Woolley.

Now you will not convince me that a man who plays such havock with words can be accurate and precise. Mr. Carleton, who, as I shall mention later, has collected a creditable amount of materials, is guilty of further inaccuracy too. On page 56, after having carefully stated, and most correctly, our ignorance on a subject, he exclaims: "But there can be no certainty in the matter until much—very much—more evidence is brought to hand." This happens to be one of those unnecessary and ponderous overstatements that irritate the reviewer. The fact is that not much, not very much, but exceedingly little fresh evidence, provided it was good, solid evidence, would be quite sufficient in the matter: for instance a nice little inscription would completely suffice for me, thank you.

On page 73 he writes: "The Sumerians were most determined polytheists, and a complete list of merely the names of their different gods would fill a book." There is a neat little exaggeration for you. No doubt the Sumerians were "determined" polytheists (a charming Irish way of putting it), but their names alone would fill only a few pages, not a book.

But Mr. Carleton's mistakes would fill, almost, a small book. His Greek must be shaky, for he writes Istanbūl (it comes from Greek *polis*, and the correct spelling is with a short *u*, not a long one); his French *répoussé* has one more accent than necessary; he spells Brahma (or, if you wish, in modern Hindi: Brahm) as Brām, the river Rāvī he writes with a short *i*; and he makes Larkāna (Sindh) every time into Nārkāna.

On page 138 we read: "At the present day, *all* the languages of Europe, save for Basque, Turkish and Maltese, belong to the Indogermanic family." (The word *all* is printed in Italics in the original.) This leaves out about 25 million non-Indogermanic people. There are the Hungarians (about 16 millions), the Finns (about 4 millions), the Estonians, the Lapps, the Ural tribes (Ostyaks, Zyryens, Votyaks, Cheremis, etc.) all speaking the Ural-Altaian tongues which he completely forgot.

His little exaggerations are characterized by the title of the book. To speak of "Buried Empires" where well over two-thirds of the book deal with petty city-states, with probably only a few thousand inhabitants, is typical of the whole book. It is true that a few rulers obtained larger suzerainty during the period under his discussion, and a few of them, no doubt, could justly be called Kings; perhaps the largest domain may well have covered the area of present Iraq. On page 99, recounting the boasting text of Eannatum, the author says: "The conquests claimed by this formidable prince are very extensive." A detailed examination of a map would prove that most of his conquests were small cities twenty to forty miles away from his own; an excursion to about one hundred miles is only vaguely possible; but of an effective hold on even as large a country as, say, an Indian province, is more than doubtful.

But with all these exaggerations, Mr. Carleton's book contains much useful material. It is the more regrettable that a man of his reading and his ability for fortunate expression should have allowed himself to be carried away by oratory. Why call a piece of goldwork, however successfully done, "unquestionably the finest example of ancient goldwork in the world"? I have seen the original and I can show the author a number of other pieces of equal workmanship.

I liked the division and arrangement of the subject. After an introductory chapter of great use, we have the earliest remains from Susa, al-'Ubaid, Jemdet Nasr, etc., followed by a good account of Sumer and Akkad. The merely historical materials are well dished up alongside with garnishings of archæology and art history (though at the latter the author has an untrained eye). Some of Mr. Carleton's theories are unorthodox, which is not, by any means, a fault, but they should be justified. Such, among others, is his idea that the original inhabitants of Sumer belonged to the Armenoid race: a hypothesis no one, to my knowledge, holds to-day (pp. 86–87). His chronology, at the time of writing the book, was not far out of date; but he, most commendably, revokes all his datings in an appendix dealing with the discoveries at Mari. As is also known, practically not a single date originally suggested by Sir Leonard Woolley is now accepted.

From our Indian point of view particular interest attaches to the chapter called "The Cities of the Indus" (pp. 137–66). These chapters are now out of date. The author

read Sir John Marshall's and Mackay's *Mohenjo-daro and the Indus Civilization* and Dr. Mackay's smaller book, *The Indus Civilization,* to both of which he gives handsome praise, though I would like to mention that he entirely underestimates Dr. Mackay's rôle in these excavations. But Mr. Carleton has not read Mackay's wonderful publication in two large tomes, and, evidently, he has not read any of those numerous articles written on the subject and published in various periodicals. The more it is to his credit that his dating of this culture is, according to latest estimates, still correct. On the whole, considering his reading matter, Mr. Carleton gives a fair account of the Mohenjo-daro finds up to 1930 or so. There is much that could be corrected in the light of recent discoveries, but one glaring misunderstanding needs special mention. This is contained in the sentence on page 157: "There seems, at least, to have been no very glaring contrast between the status of different classes." Surely, exactly the opposite is true. The Mohenjo-darians, as anthropological examination proved, belonged to a number of races; there can be little doubt that there was an upper, ruling class, whose culture and standard of life was vastly superior to that of the lower classes. The latter must have lived a life of practical slavery. A number of pictographs actually depict slaves. There is a huge gap, of, say, a thousand years' development, between the sculpture of the upper classes, exquisite, refined, expensive, discriminate, on the one hand, and the perfectly archaic, primitive, barbarous pottery figurines of the lower classes, on the other. Whereas the rich wore bead necklaces made of semi-precious stones and gold and silver and faience, the poor had to be satisfied with pottery beads; instead of bangles made of copper, bronze, silver, gold and stones, the poor wore imitations made of clay. Whereas the upper classes, it appears, used copper for their utensils, this metal was then still too expensive for the poor who continued to use stone implements. Finally, a constant rebuilding of the city, after every flood, cannot be understood unless we postulate the existence of cheap or free labour. In fact, everything points to a tremendous gap between the culture of the upper classes and that of the lower ones.

I would not like to leave the reader with the impression that this is a miserable book; for it is nothing of the kind. It is a well-written popular summary of much of our knowledge of the Near and Middle East (though Persian archaeology is neglected). It is a less reliable volume than Gordon Childe's *New Light on the Most Ancient East*, though more popular and covering a smaller area; but it is a thoroughly readable account for a layman of the history of ancient Mesopotamia and India from c. 3500 to c. 800 B.C., as revealed by recent discoveries in the field.

But my most serious grievance against this book is in the matter of illustrations. There are two excellent maps at the end, and a few really good illustrations; but, oh, how few! The publishers must realize that you cannot talk all the time about antiquities and not show them. Line drawings, used as text-illustrations, are better than nothing; pottery, metal objects, foundation plans and the like, can be shown really very well in text-illustrations which are very cheap; sculpture and the like can be given a few well-chosen plates. Here a little wisdom is necessary. There is, *e.g.*, opposite page 62, a plate containing two almost entirely identical photographs of one and the same object: truly, the height of foolishness! And why show the skeletons from Mohenjo-daro when it says so little of its culture? Would it not have been wiser to have a plate containing ten to twelve specimens of various seals from Iraq and India? With a little thinking many of the illustrations could have been made smaller and implemented by other, equally important pictures: for, after all, this is a book based on objects found in excavations.

To sum up: this is, no doubt, a well-intended book, with many good points, extremely readable, and suitable as a first introduction to the subject; with some critical trimming here and there, and with the addition of a number of fresh illustrations it could be made into an outstanding manual of really great value.

C. L. FABRI.

HIS HIGHNESS MAHARAJA
SRI JAYA CHAMARAJA WADIYAR BAHADUR

THE tidings that the Crown Representative has invested His Highness Yuvaraja Sri Jaya Chamaraja Wadiyar Bahadur with full ruling powers as successor to His late Highness Sri Krishnaraja Wadiyar Bahadur have been received in Mysore with universal rejoicing, and welcomed throughout India by Princes and people. The auspicious ceremony of formally installing the young Maharaja on the Throne of Mysore has been fixed for the 8th of September. We beg to tender our homage of respectful felicitations to the young Maharaja, and pray that Providence may bless him with long life and a happy and prosperous career.

THE ROYAL BOTANIC GARDEN, CALCUTTA*

THE Royal Botanic Garden, Calcutta, situated on the bank of the river Hooghly and only a few miles from Calcutta—the second city of the Empire, offers remarkable parallel to the Royal Botanic Garden, Kew, which is situated on the bank of the river Thames and is only a few miles from London—the first city of the Empire. But the Royal Botanic Garden, Calcutta, has a little different origin from its sister garden—the Royal Botanic Garden, Kew, which owes its origin to the interest in botany of royalty. The Royal Botanic Garden, Calcutta, on the other hand, like many other overseas botanic gardens was founded with economic and scientific aims.

Col. Robert Kyd of the Bengal Infantry, the then Superintendent of the Hon'ble Company's

COL. ROBERT KYD

Honorary Superintendent of the Hon'ble The East India Company's Botanical Gardens at Calcutta, 1786–1793

dockyard and Secretary to the Military Board of Fort William, a keen horticulturist, suggested on the 1st January, 1786, to the Governor-General to form a botanic garden in Calcutta. Without delay the present site, then measuring about 310 acres immediately below Kyd's private gardens, was acquired and the work of developing this area into a botanic garden commenced with Kyd's valuable collection of exotic plants. Kyd was appointed as the Honorary Superintendent of the Garden. When the East India Company dissolved, all the rights, duties and privileges were assumed by the Crown and the Garden became Her Majesty's Botanic Garden. The epithet 'Royal' came to be applied to it after the Queen's Proclamation of 1857. Kyd continued to perform the duties as Superintendent until his death in 1793.

Dr. William Roxburgh, the Company's Botanist in Madras, was appointed as the first official Superintendent in 1794. Roxburgh was the first to draw up a catalogue of 3,500 plants then growing in the Garden. Roxburgh's works —*Hortus Bengalensis*, *Flora Indica*, *Plantæ Coromandelinæ*—fully entitle him to the title of "the father of Indian Botany". Roxburgh died in 1815. H. T. Colebrook, Dr. Francis Hamilton (afterwards Sir Buchanon Hamilton), Nathaniel Wallich, James Hare, Thomas Carey successively held charge of the Garden from 1813 to 1816.

In 1817, Nathaniel Wallich was appointed and held office until 1846. At his time the eastern portion of the garden measuring 40 acres was given up by Government to the Lord Bishop of Calcutta as the site for a Christian College, which since 1880 is known as the Bengal Engineering College, Sibpur. In 1836 about 2 acres of land were allotted to the Agricultural and Horticultural Society of India where the Society in co-operation with the Garden officers conducted the greater part of its operation till 1872, when the Society's garden was transferred to its present site in Alipur. Dr. N. Wallich undertook an expensive survey of a large part of the Indian Empire; his enormous collections were catalogued and named in Europe by himself with the help of other botanists. A more or less complete set of this valuable collection is still in the Calcutta Herbarium together with his voluminous irreplaceable catalogue and his correspondence from 1794 to 1829. Dr. Wallich retired after 30 years of service in 1846 and died in 1854. During Wallich's absence on leave Dr. W. Griffith officiated and while on botanical expedition in Malaya died in Malacca in 1845. Dr. Griffith suggested many improvements of this garden, herbarium and the library which were subsequently followed by Dr. King to a certain extent. Dr. Wallich was followed by Hugh Falconer, who held office till 1855. From 1855 to 1871 Dr. Thomas Thomson, the joint author of the *Flora Indica*, Dr. T. Anderson and Mr. C. B. Clarke held charge of the Garden.

In 1864 occurred the great cyclone of Calcutta. It was accompanied by a storm wave from the river Hooghly that laid the greater part of the Garden under water. Over a thousand trees, at least one half of the total number in the Garden and innumerable shrubs were prostrated. Three years later a less severe but still very destructive cyclone completed the ruin. In 1871 Dr. (Afterwards Sir) George King took charge of the Garden, which was in a most unpromising state; and Sir George set to remaking of the Garden. It was due to his efforts that numerous wide roads were made all through the garden, valuable collection of dried plants were suitably housed in a handsome building, new propagating houses, tool and plotting-sheds and good dwelling houses for the members of the Garden establishment,

* Abstract of a lecture delivered by Dr. K. Biswas, M.A., D.Sc. (Edin.), F.R.S.E., at the Indian Museum, Calcutta, on 15th March, 1940.

were erected. King made enormous and remarkable contributions towards Indian Botany and initiated the publication of the world famous *Annals of the Royal Botanic Garden, Calcutta*, in 1887. The Botanical Survey Department of the Government of India, the oldest of the Surveys, was established at this time with Sir George's effort and the publication of the *Records of the Botanical Survey of India* was initiated in 1892 when the first volume of the publication appeared. Sir George King retired in 1897 after 26 years of meritorious service.

Lt.-Col. (now Sir) David Prain succeeded Sir George King as Superintendent of the Garden. Before he left India in 1904 he sketched out a geographical plan of garden divisions in accordance with which future plantings were to be regulated. Sir David's plan, with slight modifications continued to be carried on by his successors up to the present day. Sir David gained world-wide reputation by his valuable botanical publications and his scientific investigations of considerable value to the State. Sir David who is now about 85 is still actively engaged in botanical work.

Herbarium Building: Royal Botanic Garden, Calcutta

Lt.-Col. A. T. Gage, first appointed as Curator of the Herbarium, succeeded Sir David in 1906. A catalogue of non-herbaceous phanerogams cultivated in the Royal Botanic Garden, Calcutta, prepared during his time was published with the object of facilitating the exchange of plants, seeds, etc., with other botanical institutions. In 1908 during his absence on leave, Mr. W. W. Smith, (now Sir W. W. Smith, Regius Keeper, Royal Botanic Garden, Edinburgh), officiated as the Superintendent of the Garden. Lt.-Col. Gage retired in 1923 and was succeeded by Mr. C. C. Calder. Mr. Calder retired in December last year and has been succeeded by Dr. Biswas, the present incumbent.

In the open garden there are about 15,000 trees and shrubs. In addition to these there are several thousand herbaceous species in the palm-houses, orchid-houses and ferneries. The scheme adopted 34 years ago was to treat the garden as a map of the world on Mercator's projection representing the tropical floras. The plants of India and Burma are to occupy the central triangular area of the large western part of the Garden, this area being again subdivided in accordance with the geographical subdivisions of the Indian Empire. Scattered throughout the Garden are 26 irregular lakes, some of which are of large extent with islands. Altogether the lakes comprise about one-ninth of the total area of the Garden.

The Garden which is open from sunrise to sunset daily is now accessible both by roads and by the river. Near the river-gate is the nursery, the centre of all kinds of horticultural and arboricultural activities of the Garden. Passing through the Oreodoxa Avenue from the river gate one reaches the Orchid House, the large and the small palm houses where are kept in artistic beds selected ornamental and delicate herbaceous species and rare palms. Near the Orchid House are conifer group adjacent to the flower garden and the palmatum. Within close range of the palmatum are Mahogeny and Albizzia avenues. To the right of the Mahogeny avenue lies the Bambusetum. Near this area are also visible the fibre plants—Agave fourcroydes—which flower once in their life and then gradually die like many of the bamboos.

From the river gate runs the Banyan avenue and a visitor can reach the great Banyan after five minutes' walk from the river gate. The great Banyan is now 171 years old. The crown is 1,100 ft. in circumference and there are about 666 aerial roots. In 1895 the girth of the main trunk was 51 ft. The tree suffered to a certain extent during the cyclones of 1864 and 1867 and some of its main branches were broken and thus exposed the tree to the attack of a hard fungus. The trunk thus decayed by fungus and subsequent attack of insects had to be removed some time after 1920. Series of major operations were performed and by grafting a daughter tree fresh energy has been infused. Attempts are now being made to extend the branches across the road round the Banyan circle like a canopy overhead. The tree is flourishing quite well.

The Herbarium

The Herbarium and the Library developed since the foundation of the Garden in 1786. The present damp-proof and fire-proof building, especially designed to house nearly two and a half million authentic sheets of Herbarium

specimens which form the basis of all botanical and allied investigations, was erected in 1883. In this Herbarium all these precious sheets consisting of irreplaceable types, cotypes, ecotypes, etc., are arranged in proper scientific order. The Herbarium is thus the depository of a very complete collection of the dried materials of plants of the whole of the Indian Empire as also fair collection of those of Asia outside India, of Europe, and Australia, Africa and America. This is the only place for botanical investigation of its kind in India and is recognised as the National Herbarium not only in India but also in the East by the International botanical organisations of the world.

Introduction in India of Quinine, rubber, ipecacuanha, various timber trees, fibre and oil-yielding plants and other plants of great economic value is mainly due to exploration by the scientific officers of this Garden. Various other useful plants, such as jute, tea, potatoes, coffee, sugarcane, flax, rhea, singal hemp, tobacco, coffee, cocoa, rubber, indigo, fodder grasses, were introduced through this Garden. Almost all the road-side trees and ornamental garden plants now found widely grown all over India and Burma were first acclimatised in this Garden. They were then distributed all over India and abroad. Of recent introduction is the tung oil tree which is a source of considerable revenue in China. Experiments at this Garden indicate possibilities of cultivation of tung-oil in suitable areas of Bengal, Assam, Bihar, Mysore and North Burma. In Bengal the drier lower ranges of the Himalayas between 2,000 to 5,000 ft. is likely to prove suitable for cultivation of tung-oil tree. Reports of successful cultivation from Assam and some parts of Bihar are promising. Some ornamental and economic plants of recent introduction are *Victoria Curziana*, *Erythroxylon coca*, yellow lotus, *Musa rosacea*, *Cympogon Martinii*, *Aquiloria agollocha* (Aguru), *Durio zibethimus* and many others.

On the 6th January 1938, the 150th birthday anniversary of this Garden was held which happily coincided with the Silver Jubilee Session of the Indian Science Congress held in Calcutta. Encouraging messages and greetings from far and wide were received and many distinguished botanists took part in the celebration of the sesquicentenary of the Garden.

THE ELECTRIC DOUBLE LAYER*

SOME time ago, the *Faraday Society* considered that a symposium on Electric Double Layer would give rise to valuable discussion. Unfortunately, owing to the outbreak of war, it was not found possible to hold the discussion, but as many interesting contributions had already been received, the Society considered it desirable to publish them together in one volume. It is with the greatest interest that workers in Colloid Chemistry and allied branches of science, will study this monograph which contains a collection of contributions from almost all the prominent workers in the field.

The several contributions have been conveniently classified: Part I deals with experimental methods and results, and is subdivided into three groups of papers on electrophoresis, streaming effects and surface conduction, and electrocapillarity and other methods. Part II deals with the theoretical treatment of the Double Layer and its implications. Here electrokinetic equations, adsorption potentials and colloidal stability are the subjects of discussion. Part III deals with biological and technical applications.

In the introductory paper, E. K. Rideal (pp. 1–4) has discussed the various mechanisms of the formation of the electric double layer in colloidal systems. Abramson (pp. 5–15) has dealt with the potentialities of the Northrop-Kunitz cell and the Smith and Lisse apparatus for micro-cataphoresis and has discussed the application of the former to the elucidation of the changes in the number and orientation of the polar groups of organic ampholytes on adsorption. It has been shown how the asymmetry of the ampholyte ions could be calculated from electrokinetic data. Tiselius and Svensson (pp. 16–22) have studied the effect of salts on the electrophoretic mobility and the isoelectric point of egg albumin. The isoelectric point shifts towards the acid side as the ionic strength is lowered and is to be connected with the combination of ions other than H^+ and OH^- with the protein. The reduction in mobility caused by increasing ionic strength can be explained on the basis of the Debye-Huckel-Henry theory of electrophoresis. An interesting large-scale electrophoretic separator in which the substance to be separated flows as a thin layer between layers of electrolyte has been described by Philpot (pp. 38–46). Kerwick (pp. 47–52) has shown how the Lamm's scale method is used for the electrophoretic analysis of protein mixtures. The electrophoretic mobilities of dispersions of octadecane in presence of salts at constant pH, have been studied by Ham and Dean and they have discussed the results in relation to the thickness and the charge density of the double layer. Their results indicate that Guoy theory demands far too rapid a decrease in thickness of the electric double layer with increase in electrolyte concentration. When streaming potential measurements are made with many pure organic liquids through aluminium oxide and cellulose diaphragms (Gortner, pp. 63–68), interesting conclusions can be drawn regarding the orientation of adsorbed molecules at interfaces.

The importance of surface conductance in the calculation of ζ-potential has been brought out by Rutgers (pp. 69–80) and this is supported by his measurements of streaming potentials in

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* *Transactions of the Faraday Society*, 1940, **36**, 1–322.

capillaries of different sizes. The anomalous behaviour of ζ-C curves for solutions of potassium chloride can now be adequately explained. Craxford (pp. 85–101) has critically surveyed the electrochemistry of simple interphases giving complete interpretation of the electrocapillary data obtained with mercury-solution interphases. According to Hartley and Roe (pp. 101–09) the problem of the electro-chemistry of micelles can be tackled from a new angle of view. It is possible to derive simple expression for concentrations of ions at the surface of a colloidal particle in terms of the ζ-potential. These theoretical considerations have been supported by the results obtained by a new line of experimental work, *viz.*, the determination of pH at the surface of micelles and in the bulk in paraffin-chain salt solutions. The importance of the ionic concentrations at interfaces in physico-chemical problems is pointed out. The potential ψ_0 defining the potential barrier for the accumulation of capillary active electrolytes and interfaces[1] has been identified with the ζ-potential. The reviewer would like to point out however, that ψ_0 cannot be identified with ζ. For ζ determines the work to be done to bring an ion to the mobile sheet of the electric double layer, whereas for stabilisation at the interface it would be necessary for the capillary-active ion to get into the plane sheet of the double layer. The transference of the capillary-active ion from the diffuse portion to the plane sheet is not a simple process; work would have to be done corresponding to $\Sigma_{\text{stern.}}$ (*cf.* p. 112). So cataphoretic measurements would not be helpful to get an idea of ψ_0.

The second part of this symposium on the theoretical treatment of the double layer, starts off with an introductory paper by Kruyt and Overbeek (pp. 110–16) who have discussed a new and simple method of H. de Bruyn for the determination of ζ-potential. Among the other papers in this section may be mentioned the theoretical treatment by Hermans (pp. 133–39) of the relaxation effects in the electric double layer with special references to electrophoresis and the discussion on the significance of ζ by Guggenheim (pp. 139–43). Audubert (pp. 144–53) has dealt with the application of the Debye-Huckel theory to disperse systems; and Bikerman (pp. 154–60) has indicated how the surface conductance of capillary and colloidal systems necessitates an alteration of most electro-kinetic equations. The corrected equations account for the maximum of electrokinetic potential, the high dielectric constant of sols, and so on. Considerations based on surface conductance, moreover, render unambiguous the order of magnitude of the electrokinetic potential. Regarding adsorption potentials, Dean, Gatty and Rideal (pp. 161–79) have expounded an interesting theory of adsorption potentials on the basis of which the results obtained on investigating the oil-water interfaces by a new technique have been explained.

[1] Doss, *Kolloid. Z.*, 1939, **86**, 205.

According to Hamaker and Verwey (pp. 180–85) there is a general parallelism between the formation of deposits by electrophoresis and the formation of a sediment by gravity. Hamaker (pp. 186–91) has further discussed how the various forces involved in the sedimentation process depend on particle size. Derjaguin (pp. 203–14) has given a general theory of interaction of surfaces and applied it to the calculation of velocity of slow coagulation. By a new technique, he has brought evidence for the existence of long-range molecular forces acting over a distance of the order of $0 \cdot 1\,\mu$. The nature of the forces is obscure; they are not of the electrostatic, dipole or the van der Waals type. The reviewer is of opinion, however, that the whole phenomenon is connected with the irregularities of the surface of the solid against which the bubble is pressed. The retention of the liquid film appears to take place in the troughs at the surface and is presumably brought about by capillary forces. This idea is supported by the experiments of Derjaguin on hydrophobic surfaces (p. 214); no liquid can be retained by capillary action in hydrophobic cavities and hence this effect does not occur at surfaces coated with calcium stearate or paraffin. Levine and Dube (pp. 215–28) have discussed the stability properties in hydrophobic sols. There is no particular upper limit or range of values to particle size in stable sols. According to Eilers and Korff (pp. 229–40), the assumption of a "critical potential" has no adequate foundation. The stability of the lyophobic colloid systems is determined by the energy required to bring together two particles of the dispersion against the action of their electric field. Experiments in which surface-inactive substances have been employed for stabilising the emulsions of amyl alcohol and water are described by Cheesman and King (pp. 241–47).

The phenomena of electric double layer formation and its effects find wide use in biological studies and in industry. According to Moyer (pp. 248–56) significant changes in electric mobility of certain bacteria are noticed with age of culture and the electrophoretic mobility of the latex particles is useful in characterising the different species of latex producing plants. The roll of electric double layer in virus stability has been discussed by Macfarlane (pp. 257–63). Other applications as in rubber technology, in wetting and flotation phenomena, and in electrodeposition of suspended solids, are described in a series of five papers. Finally Mattson and Wiklander (pp. 306–19) have discussed the simultaneous exchange of anions and cations at the equi-ionic point of sols which takes place in accordance with the Donnan equilibrium.

An attempt has been made in this review to present some of the broad ideas contained in the symposium number. The comprehensive monograph covering over three hundred pages of closely printed matter is undoubtedly a useful and up-to-date reference work to those engaged in colloidal and electrochemical investigations.

K. S. GURURAJA DOSS.

CENTENARIES

Rickman, John (1771–1840)

JOHN RICKMAN, a British statistician, was born at Newburn, 22 August 1771. He graduated in 1792 from Lincoln College and conducted for some time the *Commercial, agricultural and manufacturer's magazine*. In 1796 he wrote a paper on taking of a census of the population.

First Census Act

This paper went to the notice of Charles Abbot, the Speaker, who took him as his secretary and employed him in preparing the first census act, introduced in December 1800. He was also chosen to examine and digest the census returns of 1801, 1811, 1821 and 1831. His introduction to the *Population returns* is remarkable for the very able analysis which it contains of the general condition, changes and prospects of all classes of the population.

He also wrote upon life annuities in the *Medical Gazette*.

A Species in One

"You must see Rickman to know him, for he is a species in one. A new class" wrote Lamb about him on November 3, 1800. He was popular in the literary circle of London. He was so careless in dress as to have been taken by the press-gang for a common tramp but was greatly respected by his friends for his shrewd sense and wide knowledge. He became an F.R.S. in 1815 and he was elected an honorary member of the French Society of Statistics.

Rickman died of an affection of the throat 11 August 1840.

Maury, Francis Fontain (1840–1879)

FRANCIS FONTAIN MAURY, an American surgeon, was born near Danville and spent his boyhood on the farm where Dr. Ephraim McDowell invented and practised ovariotomy. Having graduated B.A. in 1860 he entered the medical department of the University of Virginia the same year. He became a graduate in medicine in 1862 and began to work in the Philadelphia general hospital. His private practice grew with unusual rapidity.

Notable Feats in Surgery

Here are some of his notable feats in surgery:—

1. Ligation of the common carotid and subclavian arteries for aortic aneurism;
2. first gastrotomy for relief of syphilitic stricture of the esophagus;
3. the first resection of a portion of the brachial plexus to relieve the pain in neuroma of the skin of the upper extremity;
4. plastic operation for extrophy of the bladder, using the flap from the perineum and scrotum; and
5. the first successful amputation of the hip joint in America.

Maury has been characterised "as a cool, dextrous, cautious surgeon, of sound judgment". He died 4 June 1870.

Perrine, Henry (1797–1840)

HENRY PERRINE, an American plant explorer, was born at Cranbury, 5 August 1797. Till 1827 he practised medicine and thereafter he became United States Consul at Campeche, Mexico.

Botanical Collections

During ten years of continuous residence in Mexico, Perrine made botanical collections which enriched the herbarium of the New York Botanical Garden.

Plant Explorer

In 1827 President John Quincy Adams caused a circular letter to be sent to consular officers to procure foreign plants of known or probable utility for cultivation in the United States. Perrin took the request very seriously and began to flood the government with detailed reports on fibrous plants.

Victim to His Own Enthusiasm

In 1838 the government approved of Perrin's suggestion to establish a tropical plant introduction station in extreme southern Florida. Perrin was granted land for the purpose; and he removed to the place and spent two years tending and extending the nurseries. Of all the tropical plants introduced by him sisal is the most noteworthy.

Perrin died at the hands of marauding Indians 7 August 1840.

S. R. Ranganathan.

University Library,
Madras.

"A long record of successful achievement in medical research stands to India's credit, particularly in the field of tropical disease" says the Public Health Commissioner with the Government of India in his Preliminary Report for the year 1939.

"As early as 1877", he points out, "Vandyke Carter discovered the causative organism of relapsing fever. Later came the demonstration by Ronald Ross of the role of the anopheline mosquito in the transmission of malaria. The monumental work of the Indian Plague Commission established the fundamental facts on which our present preventive campaign against the disease is based. In regard to Kala-azar, the causative organism was discovered by workers in India and an effective treatment was also elaborated in this country, which has converted a 95 per cent. fatality rate into an equally high rate of recovery. The latest contribution of Indian workers to medical research has been in connection with the nature of the true cholera organism, and this work has received warm appreciation from the Cholera Commission of the International Public Health Office at Paris."

SCIENCE NOTES AND NEWS

A Remarkable New Fish from Bombay.—The last number of the *Records of the Indian Museum* (42, pp. 379–423, June 1940) contains an article by Mr. C. V. Kulkarni, "On the Systematic Position, Structural Modifications, Bionomics and Development of a remarkable new family of Cyprinodont Fishes from the province of Bombay". The new fish was discovered accidentally in the backwaters along the coast of the Bombay Presidency. As this discovery is likely to throw considerable light on the relationships and evolution of the Toothed-Carps, the very careful account of the fish by Mr. Kulkarni is of very special importance.

The most significant point about the new fish is the possession by the male of a massive and highly complicated organ for the transference to the body of the female in the neighbourhood of the genital opening of spermatophores, a structure discovered for the first time among fishes. Though a similar male organ for the transference of sperms is found among a variety of American Top Minnows, its occurrence in an allied Killifish of the Asiatic Continent has been discovered for the first time. It is worthy of note that the author has not confined himself to a mere taxonomic description of the species, but has given as detailed an account as possible of its morphology, bionomics and development. In these respects it is a unique paper in which a taxonomic account of great importance is accompanied by full details of the life-history and development of the species.

The paper is divided into four parts, Systematic Account, Structural Modifications, Bionomics and Embryology including larval development. In the first part, the author has given reasons for assigning this fish to a new family and has indicated its position among the Cyprinodont fishes by giving an outline classification of the Order after the latest scheme suggested by Hubbs and Myers. The diagnosis of the new family is given and the species is described in detail. In the second part, the structure of the gonopodium is described; it is a highly complicated organ and the author seems to have taken considerable pains in elucidating the relationships of its component parts; this portion of the work is extremely valuable. Mr. Kulkarni also directs attention to the asymmetrical position of the genital opening, the presence of the genital pads and the absence of the right pelvic fin in females. Each peculiarity is fully explained and suitable arguments offered for its utility.

The section dealing with Bionomics contains an account of the author's observations on mating, liberation of sperms from the spermatophores and laying of eggs; these observations are of a very high order and deserve special notice. In the embryological studies of the species the author has brought together a mass of valuable information. Special mention may, however, be made of the study of the development of the gonopodium and its ultimate differentiation into a complicated organ found in the adult males. A useful comprehensive bibliography is given at the end. The paper is well illustrated with neat and suitable diagrams.

S. L. Hora.

Indian Vegetable Oils as Lubricants in Internal Combustion Engines.—Lubricating oil for use in internal combustion engines is mostly of mineral origin and India has hitherto been importing practically all her supplies of this essential material from abroad. Since the outbreak of war, severe restrictions have been imposed on the import of these oils and the appearance of Bulletin No. 18 of the *Industrial Research Bureau* on the "Utilization of Indian Vegetable Oils as Lubricants for Internal Combustion Engines" by J. S. Aggarwal and Lal C. Verman, is therefore very timely. The authors describe the results of preliminary experiments carried out by them on three important Indian Vegetable Oils, castor, groundnut and cotton seed. The chief defect which has hitherto stood in the way of vegetable oils being used as lubricants for internal combustion engines is the comparative ease with which they undergo oxidation at the high temperatures they are subjected to in the engine. This oxidation results in increase of (1) viscosity, (2) acid value and (3) carbon residue; all these three factors interfering with the efficient working of the engine and leading to corrosion and other troubles. Accelerated oxidation test in the presence of iron according to a modification of the Air Ministry technique have been carried out and the increase in viscosity, acid value and carbon residue measured, both with and without stabilizers. The results show that castor oil is far superior to the other two oils. Some of the stabilizers tried such as α-naphthol and hydroquinone are fairly effective in minimizing oxidation, but even castor oil, using the best stabilizer, is very much inferior to the high grade mineral lubricating oils on the market. It is necessary, however, that a lot more of work should be done and the investigation can only be regarded as a preliminary one. The results of engine trials with stabilized vegetable oils are to form the subject-matter of future papers and they will be awaited with great interest as they will be the final criterion on which the value of these vegetable oils as lubricants can be judged.

C. V.

Phosphate Manuring on Lateritic Soils.—The peculiarity of the red lateritic soils on account of their very high content of iron and alumina and their consequent ability to render insoluble and therefore non-available phosphates existing naturally in the soil and that which may be applied in a soluble form as fertiliser, constitutes a difficult problem in judging the quantity and mode of application of phosphate manures on such soils. Their content of iron and alumina is so great that they can immobilise soluble phosphates running in to even a hundred tons per acre, compared with which

the ordinary doses of a few hundredweights applied in practice amount to almost nothing. How then can the difficulty be got over? Neither lime nor organic matter nor any chemical amendment can minimise the high phosphate fixing capacity of these soils. Resort has to be made to practices designed to favour the plant in procuring its phosphate supply without an undue proportion being fixed by the soil (N.H. Parbery, *Agr. Gaz. of New South Wales*, 51, Part 4). In this view the placement of the fertiliser in the course of manuring is of paramount importance to ensure that the roots will enter the zone of phosphate fixation early in their development and before fixation by the soil has proceeded far. Superphosphate is adapted for this purpose as it is in granular form and as its phosphate diffuses only slowly through the soil moisture and, if the placement is correct, into the radius of the absorbing roots themselves. Fertiliser in coarse granular form and application in close proximity to the spread of the absorbing roots are therefore recommended; the quantities, however, are not indicated but a regular yearly dressing of superphosphate will be necessary. We may add that a practical way of judging the dose has long ago been suggested by Wagner according to which the maximum dose beyond which there is no response to superphosphate is found by experiment and thereafter only the quantity removed in the form of crop and other plant material is supplied as the yearly dose of the fertiliser. The problem in all its aspects is of great importance to South India, in view of the predominantly lateritic nature of its soils.

A. K. Y.

Affinities of Symphyla.—A monograph of considerable importance throwing fresh light on the bearing of Symphyla (Myriapoda) on the question of the inter-relationship of the different orders of Arthropoda and especially on the origin of insects has been published by O. W. Tiegs (*Quart. Journ. Micros. Sci.*, 82, Pt. 1, 1-225). The author has studied the anatomy and embryology of *Hanseniella agilis* and has come to certain important conclusions regarding the affinities of the group (Symphyla) to which this animal belongs. The origin of both the Myriapoda and Insecta can be traced back to a Peripatus-like ancestor acquiring an increasingly perfect adaptation to life on land. The modification of the anterior segments and their incorporation in the head, the development of the Malpighian tubes from the hind gut, and the formation of eyes from groups of ocelli are all to be considered as attendant consequences of this land habit. From this protomyriapod ancestor was given off the Chilopoda which have a head simpler than in any existing myriapod or insect. The labium was a later addition and here arose the insects on the one hand and Diplopoda on the other. The insectan line is characterised by the development of a hexapod condition, the distinction between the thorax and abdomen, the development of compound eyes and the retention of the opisthogoneate condition. The specialisation along the diplopod line consisted in the production of diplosegments, the formation of the gnathochilarium by the fusion of the maxillæ and the labium, and the formation, secondarily, of an anterior reproductive aperture. The Symphyla probably originated at the point of bifurcation of the ancestral stock into Insecta and Diplopoda, with the important diplopod character, *viz.*, the progoneate condition, incorporated in it. The development of *Hanseniella* corroborates this view.

Age of Manganese Ores in Central Provinces.—Doubts which have for long been entertained as to whether the managanese ores occurring in the Chchindwara, Nagpur, Balaghat and Bhandara Districts of the Central Provinces are in the main of the same age or whether the Balaghat-Ukua deposits are younger than those found further west in the Chchindwara and Nagpur Districts, have been dispelled by a recent study made by Sir Lewis Fermor, late of the Geological Survey of India. Sir Lewis inclines to the view that the deposits are of the same age and is of opinion that the differences are probably due to the fact that rocks at the western end of the belt have undergone a severe metamorphism than those at the eastern end.

The results of the study are published in a memoir of the Geological Survey of India, which deals with Archæan rocks of Chchindwara, Nagpur, Balaghat and Bhandara Districts of the Central Provinces. This tract of Archæn rocks includes the most important manganese deposits of India.

Endemic Fluorosis.—The latest report of the Public Health Commissioner with the Government of India includes an account of the studies relating to fluorosis which was first reported in 1936. The disease is characterised by a definite train of symptoms such as stiffness and pain in the spinal region and in various joints. A detailed study of this condition was carried out by the Health authorities of that province and it was shown to be one of chronic fluorine intoxication resulting from the continued use of water containing fluorides.

The problem is two-fold, namely, the prevalence in a comparatively wide geographical area of a dental condition, commonly known as "mottled enamel", and the occurrence in a restricted area, of severe manifestations of chronic fluorine intoxication involving the spine, joints and ligaments to which the name of endemic fluorosis has been given.

The presence of fluorides in drinking water supplies has been demonstrated over a fairly wide area in Madras, although sufficient work has not yet been done to de-limit the fluoride areas in the province.

During 1939 detailed house-to-house surveys were carried out in certain areas to ascertain the incidence of the condition with special reference to the customs, dietetic habits, length of residence in the affected areas and occupation of the inhabitants. These surveys have yielded valuable results.

The survey revealed that even with a high fluoride content of the water used for drinking and cooking, the incidence and severity of chronic fluorine intoxication is greatly influenced for the better by a well-balanced diet; that even

with a comparatively lower fluorine content in the water, an insufficiency of vitamin C and a high calcium value in the diet results in a higher and more severe incidence of fluorine intoxication, even the younger adult age groups becoming affected; and that in the absence of fluorides in the water, these dietetic deficiencies produce neither mottling of enamel nor bone manifestations.

Laboratory experiments on monkeys have confirmed these findings of the field survey. Two factors therefore, appear to be important in the production of fluorine intoxication, *viz.*, the presence of fluorides in toxic doses and an unbalanced diet with a pronounced deficiency of vitamin C.

Research work in the removal of fluorides from water has been carried out at the King Institute, Guindy. No method has so far been evolved for removing these salts from natural waters at what may be considered a cheap cost. It would therefore, appear that the practical solution of the problem cf endemic fluorosis should be sought by remedying the nutritional defects of the population.

Indian Ephedra.—The concentration of the active principle in the Indian ephedra is comparable with that in the Chinese ephedra, which till lately constituted the chief source of supply of this drug, according to investigations carried out in the Forest Research Institute, Dehra Dun. Publication of the results cf these investigations has attracted the attention of the drug market of the world to India as a possible source of supply of this drug, which is a potent remedy for asthma and hay fever.

Indian ephedra is now being exported to the United Kingdom, but till 1938, export to the United States of America was almost negligible. In 1937, China exported ephedra to the extent of over two million lbs., of which the United States of America alone took 1,196,000 lbs. But in 1938, when supplies from China and Spain were reduced by wars in those countries, India exported to the United States of America 446,300 lbs. of the drug worth about Rs. 88,000.

If Indian ephedra is to establish herself in the American market—for which this is the right time—there must be a regular supply of the drug of uniformly high quality. This can only be ensured if the right species of the plant are collected from suitable localities and at the proper season. Failure to attend to these essentials in the past, stood in the way of India's getting a permanent foothold for her produce in the world markets.

Progress of Broadcasting in India.—The first Annual Report of the All-India Radio up to March 31, 1939, which has been recently issued, traces the development of broadcasting in India from a Radio Club at Madras in 1924 to a complex Government-controlled organization of seven stations and twelve transmitters, with a total income for nine years of over one crore rupees.

With the Bombay Station of the Indian Broadcasting Company which was opened in 1927 began the history of regular broadcasting in India. Then the number of licensed listeners was under 1,000, seventy-two times less than the number of licences in force in 1939. Gross licence fees in 1938-39 amounted to Rs. 7,50,261 and gross customs revenues to Rs. 13,70,320. Total programme transmission hours on the medium-wave rose to 16,670 and on the short-wave to 13,189.

With regard to radio programmes the All-India Radio has had to tackle, more directly than any other single institution, the problem arising out of a multiplicity of languages and complicated by a linguistic outlook of peculiar fluidity. Amidst a diversity of opinion, All-India Radio cannot hope to win universal approval in its linguistic efforts, but an attempt is made to proceed cautiously, though not illiberally, and to combine minimum diversity with maximum intelligibility.

It is yet too early to say how far the present educational policy of All-India Radio meets the requirements of the schools concerned. The object of school broadcasts is to supplement the work of the teacher, not to replace him. Widening the mental horizon of the students, and supplying such information and instruction as may be beyond the reach of the average institution ... these constitute the double objective of school programmes.

A special feature of the Report is the large amount of information of a technical and engineering nature which includes a full account of the important work of the Research Department on the measurement of atmospherics in India, a report on field strength measurements of medium-wave stations, and technical information on the short-wave service. There are also separate chapters on the technical features of the Lahore Broadcasting centre, the new All-India Radio transmitting equipment, the design of studios, the village receiver and the Todapur receiving centre.

Indian Central Cotton Committee.—The progress of work done to improve and develop the 'growing, marketing and manufacture of cotton in India' during the last year is recorded in the Annual Report of the Indian Central Cotton Committee. The Report gives in detail the various researches conducted under the auspices of the Committee in several laboratories and agricultural research institutions. Fundamental research on cotton genetics, physiology and agronomy has been carried out at the *Institute of Plant Industry, Indore*, and many interesting results have been obtained. The Official Testing House of Cotton at Matunga conducted several researches relating to cotton technology, the most interesting of which was the investigation on the absorption of dyes by Indian cottons. The results obtained under several research schemes, by the agricultural departments of the Provinces and States are also recorded in this Report. The success achieved in the seed distribution schemes and in the introduction of improved varieties of cotton is not very striking and it is to be hoped that the Committee will spare no effort to bridge the gap between the experimental station and the cultivator and effect the maximum improvement in agricultural practice in as short a period of time as possible. The incorporation

of Cotton Statistics and various Acts relating to cotton control, cotton transport, etc., makes this Annual Report invaluable to all those who are interested in cotton in some way or other.

P. S. S.

Researches at the Lac Research Institute, Namkum.—An important section of the work done at the Institute, has been the production of shellac moulding powders, states the annual report of the Institute for the year 1939–40.

The Institute has developed or adapted methods for the manufacture of urea and formalin in quantities sufficient for moderate-sized factories and work has been done with a new chemical which has the property of further improving the quality of shellac-moulded articles.

This substance, melamine, is easily prepared from calcium cyanamide which, though not manufactured in India, is available in large quantities, being one of the basic fertilisers. The use of much smaller quantities of this melamine than urea is an economic advantage as well, and it is expected that it will play an important part in shellac mouldings in future.

It is with the same idea of developing a moulding industry entirely based on indigenous raw materials that two other powders have been formulated; a shellac-casein and a shellac-coal-tar powder.

As a result of researches carried out at the Institute, it is stated, that shellac injection moulding, as distinct from compression moulding, promises a great future in the production of electro-technical goods. Already the Institute has been able to produce by this method electrical switches which can be sold much more cheaply than those made by compression moulding due to the higher rate of production and the simplicity of manufacture of the powder.

Research on Tuberculosis.—Consequent on a recent decision of the Central Committee, *The Tuberculosis Association of India* has paid a sum of Rs. 4,000 to *The Indian Research Fund Association* for an epidemiological enquiry on tuberculosis under Dr. R. G. Cochrane, Chief Medical Officer, Lady Willingdon Leper Settlement, Chingleput, Madras. The Tuberculosis Association of India is not in a position to undertake independent research work in tuberculosis, *at present*.

A tuberculosis survey is being carried out in Vayalpad by the authorities of the Union Mission Tuberculosis Sanatorium, Arogyavara near Madanapalle (Madras). Up to the end of May 1940 they had examined 2,000 persons out of whom more than 45 per cent. were found infected with tuberculosis. From these positive cases, strongly reacting cases were taken to the Sanatorium for X-ray and 48 were detected to be suffering from the disease.

Dr. L. Sibaiya, D.Sc., F.Inst.P., F.A.Sc.—We have pleasure in congratulating Dr. L. Sibaiya on the doctoral degree conferred on him by the Syndicate of the Madras University on the presentation of his published papers relating to *Hyperfine Structure of Spectral Lines* and *The Solid and the Liquid States*. Dr. Sibaiya's researches have received the highest compliments of the examiners to whom they were submitted, and it has been pointed out that the results obtained by him have an important bearing on the problems studied. He examined the structure of the spectral lines of elements such as mercury, copper, molybdenum, platinum, iridium, selenium, palladium, gold, germanium, rhodium, etc., for which he designed special types of water-cooled sources of radiation. Sufficient theoretical and empirical information regarding the nature and origin of hyperfine structure being then available, the isotopic constitution of platinum, gold and iridium was deduced from a study of the structure of their lines, the mass-spectrograph having till then failed to reveal the isotopic constitution of these elements. The conclusions regarding the isotopic constitution and the relative abundance of the isotopes in iridium have now been corroborated by Dempster's mass-spectrographic results. Significant results have been obtained from investigations on the self-reversal and Zeeman effect of hyperfine components. A review of the problems in hyperfine structure in relation to the isotopic constitution has been reported in the columns of *Curr. Sci.*, 1939, 8, No. 10.

In the second part dealing with the solid and the liquid states, the data on the light-scattering in crystalline solids and on the magnetic investigations of liquids and their mixtures are discussed. Considering a liquid as an assemblage of monochromatic oscillators, significant relations between its molecular volume, viscosity, Raman frequencies, surface tension and compressibility are shown to follow.

Dr. S. K. Kulkarni Jatkar, D.Sc., F.I.I.Sc., F.I.C., F.Inst.P., was awarded the D.Sc. in Chemistry of the Bombay University at the recent convocation, for his thesis on "Specific Heats of Organic Vapours from Supersonic Velocity". He is the second person to obtain the D.Sc. in Chemistry from Bombay University, the first being Dr. A. N. Yajnik of Lahore.

The production of optical glass in America was started in 1917, at first as a war industry, by **Bausch and Lomb Optical Co.**, to supply the vital materials required for the pursuit of war and later on developed into a highly specialised national industry. A brief account of the development and manufacture of optical glass in America is given by M. Herbert Eisenhart and Everett W. Melson of this company in the *Scientific Monthly* (1940, 50, 323). The description includes a critical analysis of the exacting requirements of the optical glass of to-day. Great care taken in America in maintaining the purity of pots, the choice of the furnace, the composition of the batch, the mode of stirring and the process of annealing is clearly brought out.

In another useful paper entitled "Designing Corrected Lenses" by Walter Litten and issued by **Bausch and Lomb Optical Co.**, the various errors to be borne in mind in the design of photographic lenses such as spherical and chromatic aberrations, coma, astigmatism and distortion, are described in non-technical

language and remedies suggested. The development of colour photography in recent years has made the task of the lens-designer more difficult. However, the best design for monotone with panchromatic materials will also be the best design for natural colour photography. The modern trends in the design of photo-lenses are indicated.

C. S. VENKATESWARAN.

ASTRONOMICAL NOTES

The Sun enters sign Libra and is at the autumnal equinox at 10^h 16^m I.S.T. on September 23.

Planets during September 1940.—Venus reaches greatest apparent elongation west of the Sun (45° 57′) on September 5 and will continue to be a conspicuously bright object visible in the morning sky for over three hours before sunrise. Mercury is in superior conjunction with the Sun on September 4 and will not be in a favourable position for observation during the month. Likewise, Mars which has passed into the morning sky, will be too close to the Sun during the month and cannot be well observed.

Jupiter and Saturn which are apparently close to each other, rise at about 9 p.m. and are conveniently situated for observation in the latter part of the night. The former reaches a stationary point of its orbit on September 4 and begins to move westward among the stars. Saturn, about a degree and a half south of Jupiter, is also moving in the same direction. The brightness is increasing, the stellar magnitude being 0·3 in the middle of the month. The ring ellipse continues to widen and the angular dimensions of the major and minor axes are 43″·8 and 15″·3 respectively. On September 21 will occur close conjunctions of the Moon with these two planets. Uranus also is in the morning sky and will be on the meridian at about 4 a.m.

Variable Stars.—The well-known variable, χ Cygni is expected to reach maximum brightness about September 30, when it will be of the fourth magnitude and easily visible with the naked eye. The period of variation of the star is approximately 413 days and the range about 10 magnitudes, so that at minimum it can be seen only with a fairly large telescope. It is situated about midway between the two bright stars β and γ Cygni and can be readily identified. Another interesting variable, ρ Cygni —irregularly varying between magnitudes 3·5–6·0—will be found about two degrees south of the latter star.

T. P. B.

MAGNETIC NOTES

Magnetic conditions during July 1940 were comparatively less disturbed than those during the preceding month. There were 10 *quiet* days, 20 days of *small* disturbance, and 1 day of *moderate* disturbance as against 9 quiet days, 14 days of slight disturbance and 8 of moderate disturbance during the month of July 1939.

The most disturbed day in July 1940 was the 13th on which day a moderate magnetic disturbance was recorded. The quietest day during the month was the 17th. The characters for the individual days are shown below.

Quiet days	Disturbed days	
	Slight	Moderate
2, 7 8, 11, 12, 17–20, 23	1, 3–6, 9, 10, 14–16, 21–22, 24–31	13

There was one moderate storm during the month as against 5 moderate storms during July 1939. The mean character figure for the month is 0.71 while that for July of last year was 0·97.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of July 1940, one slight and three moderate earthquakes were recorded by the Colaba seismographs as against two slight ones recorded during the same month in 1939. Details for July 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T. H.	M.	Epicentral distance from Bombay Miles	Co-ordinates of the epicentre (tentative)	Remarks
July 10	Moderate	11	20	3330	In or near Korea.	* Owing to strong microseisms the different phases of this shock could not be determined with sufficient accuracy from the Colaba seismograms.
14	Moderate	11	23	5740	Near 52° N., 177° E. in the neighbourhood of Aleutian Islands.	It was reported in the papers that 300 persons were killed, several hundred injured and 12 villages were destroyed.
21	Moderate	21	09	3470	7° N., 123° E. to the south of Mindanao Island.	
30	Slight	05	42	2460	Probably Anatolia.*	

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FUEL RESEARCH IN INDIA

THE establishment of a Board of Scientific and Industrial Research for India and the appointment by it of a Fuel Research Committee has brought more prominently to the fore the question of the establishment of a Fuel Research Department or Station in India. It is too early to say whether we may confidently look forward to the establishment of a separate Department but we may reasonably hope that a start will at least be made on organized research. In this matter of fuel research India lags behind nearly all other important countries of the world and particularly behind her chief competitor in the field of fuel, namely South Africa. The establishment in that country of a Fuel Research Institute by utilising the accumulated funds of the formerly-existing Coal Grading Board should be of special interest to those concerned in this very important matter. The Committee that has been formed in India will presumably have to consider what schemes should be recommended for adoption by the existing workers or should form the basis of the work to be undertaken in the early stages by any Fuel Research Department that may be established.

Fuel research presents to the scientist a remarkably and temptingly wide field for investigation. The problems are manifold and cover such a wide variety of subjects that there is considerable risk of too many problems being tackled at one time, with consequent lack of co-ordination in the earlier stages and the necessity for later repeating of much of the work. Many important problems can have a considerable amount of light thrown on them by the investigations that have been and still are being carried out in other countries possessing greater resources than India. Some of the work that faces us cannot, however, be conveniently disposed off by mere reference to

and inference from the results of workers in other countries. It appears to the present writer that owing to the possibly limited finances of the Committee or of any body appointed as the result of its deliberations, only the important fundamentals should be tackled at present.

The present writer is particularly interested in coal utilisation research. His interest is not such as to exclude serious attention being given to utilisation of other fuels in India, but the problems facing the coal industry at the present time appear to him of such importance as to merit very early attention. The following appear to be the important matters requiring investigation, investigation that cannot be carried on without a large amount of practical work in or near the coalfields.

1. Systematic physical and chemical survey of the coals of the various coalfields in India, similar to the survey that has already produced such beneficial results in Great Britain.

2. Laboratory and medium-scale investigations of washability of second grade and low grade coal, and of slack coal of all qualities. (This would be carried out to a large extent along with No. 1 above.)

3. Large-scale briquetting tests, especially with a view to investigate the possibilities of briquetting without the use of a binder.

4. Examination of coking coals, including weakly-coking coals, in respect of swelling and subsequent contraction, with a view to aid experiments in blending.

5. Experiments on blending of coking coals with non-coking coals.

6. Investigation of the possibilities of the extended use of Indian coals, especially low grade coals, in gas producers.

An important section of the work under (1) would be a systematic investigation of the fusibility of coal ashes and a study of clinkering problems.

In addition to this fundamental work it is, in the opinion of the writer, necessary to make an immediate start on a comprehensive survey of the technical literature and the compilation of an exhaustive loose-leaf, or card, index of the bibliography, with liberal cross references, to be retained as a permanent feature in such a manner as to permit all interested scientific workers to benefit by periodical distribution of properly indexed abstracts.

An incidental result—it is to be hoped an early one—would be the devising of a system of valuating Indian coals with a view to encourage still further the purchase and sale of coal on analysis and to specification, with provision for penalties and premia for departure from the terms of specifications.

Another important feature of Section No. 1 would be the carrying out of complete ultimate analyses of all the coals surveyed, in consequence of which it would at least be possible with confidence properly to classify Indian coals according to an internationally accepted system.

It is, in the opinion of the writer, highly desirable that one centre for Fuel Research mainly concerned with problems relating to the utilisation of coal should ultimately be established in India and that that should be the final aim before the Fuel Research Committee. It is possible, however, that funds will not permit early realisation of that aim. Until it is realised, therefore, it may be desirable to utilise for the time being the services of all competent interested workers, arranging for a central distributing agency to collect samples under proper standard conditions and, after laboratory sampling, distribute them to the different workers, receiving and correlating the results.

In the opinion of the writer the bulk of the work must of necessity be organized by qualified fuel technologists working in or near one of the major coalfields. In the event of an All-India Fuel Research Station

being established, that station should also, in the opinion of the writer, be situated at a place permitting of ready access to the coalfields and personal contact and co-operation with leaders and important men in the coal, coke and steel industries. For some of the work the facilities existing at the various collieries and coke plants in the matter of supply of power, gas for special furnaces, etc., would be of inestimable benefit to the work. Proximity to the coal fields will lessen the risk of inaccurate collection of samples and also facilitate ready correction of mistakes that may from time to time arise.

Another point of importance is that, at least in the opinion of the writer, there is greater necessity for studying the application in practical form of the discoveries of other workers in the field and of the results of their researches than of instituting academic research into highly complicated chemical and physico-chemical problems. The nature of the research work facing the fuel technologist in India is on the whole simple. The fundamental necessity is the gathering together and correlating of the available information and the supplementing of it for the sake of bringing up to date our knowledge of indigenous fuels and of sources of fuels. When we know better than we do at present about our fuels, and of the sources of fuels alternative to coal and oil, we can easily say with reasonable confidence what can be done with them.

As already stated, the above remarks relate more specifically to coal utilisation research. Such fundamentally important matters as low temperature carbonisation, complete gasification of coal, conversion of coal into oil, etc., and even safety in mines research include within their scope other equally important matters not primarily connected with the study of coal itself. Other important spheres of enquiry include production of industrial alcohol, recovery of methane from sewage, utilisation of gaseous fuels in internal combustion engines, etc. All of these must in due course be taken up by workers in this country. So far as the other fuel problems are concerned much of the work already undertaken could well be continued by the present workers. Where large-scale tests and experiments are found necessary the coalfields will possibly prove to be the most suitable site for such work also. That, however, is a matter that can well be left for discussion with those especially interested. There is little doubt, however, that so far as large-scale tests on coal are concerned the advantages of proximity to the coalfields largely outweigh the advantages offered by other localities. Even in the matter of freight and ease of delivery of large samples there will be a very material advantage. In the coalfields coal costs from Rs. 2 to Rs. 4 per ton and many mining concerns are glad to supply coal free of charge for scientific investigations. Farther afield freight charges greatly exceed the cost of the coal and loading and unloading charges add to the cost.

The disadvantages of situating the centre of this proposed organization near the coalfields include (probably most important of all) the lack of technical literature for consultation. Two important educational institutions exist within reasonable distance of the coalfields, the Indian School of Mines with which the writer has been associated for over thirteen years and the Benares Hindu University. Both of these possess a useful range of technical literature and the nucleus of the equipment required for this work. Whether a Fuel Research Station should ultimately be directly connected with any existing institution, of course, is a matter for discussion. The Coal Mining Committee (1937), without adducing any evidence in support of their recommendation, and

without the matter being discussed, recommended, with respect to the proposed "Coal Research Board", that its staff should be distinct from the staff of any existing institution.

Although the context of the Report would appear to suggest that the Committee had in mind Safety in Mines Research rather than Fuel (Utilisation) Research, yet we may presume that they would have made a similar recommendation in respect of a Fuel or Coal Utilisation Research Board. Without entering into a discussion of the merits of their recommendation we may perhaps accept it as a basis for discussion and say that such a recommendation does not preclude the situation of the station at or near one of the major coalfields and if a decision is ultimately come to in favour of a completely separate new organization its situation close to one of the existing institutions would, in the opinion of the writer, bring great advantages, advantages that cannot be lightly dismissed.

It is natural that the writer should be disposed in favour of the establishment of the proposed research station at or near the institution with the direction of which he is himself concerned. It possesses the important equipment for the work, including crushing, pulverising and sampling equipment, electric and gas muffle furnaces, electric carbonisation furnaces (Lessing and Gray-King), electric combustion furnace, bomb calorimeters, pyrometers, gas analysis apparatus, the usual platinum crucibles and basins, pH value apparatus, etc., etc. It has a good library with valuable files of back numbers of important technical journals including *Fuel*, the journal of the Institute of Fuel, *The Fuel Economist, The Colliery Guardian, The Mining Magazine* and many other technical periodicals and the *Transactions of the Institution of Mining Engineers* of the Mining, Geological and Metallurgical Institute of India, and of other important societies, etc., etc., and its staff have for years been steadily acquiring an intimate knowledge of the coals of the two major fields, those of Jharia and Raniganj. Whether or not that staff would actually play any important part in the work that would be undertaken, there is no doubt that they would be ready to co-operate to the full with the staff of the new organisation. There can be little doubt that they (as well as other workers throughout the country) would, at least in the earlier days of the work, take part in it and accept responsibility for the study of certain problems.

The case for the establishment of a fuel utilisation research body (Board, Station, etc.) appears to be somewhat as follows:—

1. Fuel, and especially coal utilisation research is urgently necessary in India for the more efficient development of her resources.

2. The problem is an all-India affair and should not be tackled entirely on provincial lines.

3. The ultimate aim should be the establishment of a completely separate organisation.

4. If funds do not permit of the immediate establishment of a separate central organisation, and even if it should later prove financially possible, some of the investigational work could well be delegated to workers already in the field. But a central organisation for the co-ordination of the work, with safeguards against undue restrictions on the individuality of the research workers, would be a necessity to ensure accurate collection and identification of samples (so far as coal utilisation research is concerned) and correlation of the results.

5. Two general lines of procedure appear to call for immediate action: (*a*) a comprehensive chemical and physical survey of the important coalfields, as distinct from the geological survey that has already progressed so successfully and profitably and (*b*) a

bibliographical survey of the subject with special reference to Indian conditions, under a scheme allowing for the dissemination of the results of the survey to all authentic workers, such a survey being continued as a permanent feature.

Finally, the writer would appeal to enthusiastic scientists and quasi-scientists throughout India not to fall into the harmful error of over-stating the case for the development of India's mineral (and other) resources and their dependent industries by the results of scientific research. There is, in his opinion, a regrettable tendency just at present to paint attractive pictures of the wonderful benefits awaiting the country if only research is sponsored, encouraged and financed, a tendency to assure the uninitiated that technical success in scientific research will automatically be followed by wholesale industrial development. The coal by-product question is a case in point. Much loose talk has been allowed to find a place in the press in recent months regarding the storehouse of beautiful dyes, wonderful disease-curing drugs and valuable synthetic resins locked up in a lump of coal. Following upon these articles there have been appeals, mostly genuine and in the best of good faith, to finance this and that research, in many instances such advocated researches being, upon investigation, little more than a repetition or extension of work already excellently and for the most part exhaustively done in other countries and requiring little more than intelligent application by commercial and industrial interests. Such popular writing is an undesirable type of "appealing to the gallery".

In too many instances, it is to be feared, have glowing accounts of the promise given by this and that research been followed by disappointing silence as to the results. The consequence has been to put into the hands of those who have been over-persuaded additional arguments against the encouragement of pure and applied research.

Such a statement is not to be taken as a wholesale stricture on the initiation of research. On the contrary, research should be encouraged and financed to the utmost capacity of the country and the writer himself has, ever since his arrival in the country, pressed most strongly for a sympathetic attitude on the part of government towards research. But we should be honest in this matter and truthfully say that pure research should be encouraged irrespective of any kind of guarantee of profit arising from the results. Research is the life-blood of the scientist and of the educationist and a country that persistently starves its research workers is doomed to remain in the background scientifically, educationally *and industrially.*

But let us be modest and dignified in our claims as scientists, restrained in our self-praise at scientific gatherings and in the press, cautious (outwardly at least) in our optimism, guarding against rushing into print with the ill-digested results of research work, and honestly, quietly and sincerely persistent in effort.

CHARLES FORRESTER.

[NOTE: *The opinions expressed in this article are those of the author and are in no way to be considered as emanating from the department in which he serves or having the stamp of official authority.*—C.F.]

DAMS AND THE PROBLEM OF MIGRATORY FISHES

BY

DR. S. L. HORA

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STUDENTS of fish and fisheries in India are no doubt aware that since the sixties of the last century efforts have been made in this country to provide fish passes in the construction of dams so as not to interfere with the migration of the fishes ascending to their breeding grounds and afterwards on their return journey to the feeding grounds or *vice versa*. The available evidence goes to show that fish passes were and are still being constructed by the engineers who may be described as almost wholly ignorant of the habits of the fish that are meant to be saved from possible extermination. For instance, to save the extensive and valuable Hilsa Fisheries, the Government of Madras, at the suggestion of Dr. Francis Day, constructed fish passes, across anicuts, as early as 1869, but these proved ineffective, and after another exhaustive enquiry by Sir F. A. Nicholson in 1909, fish passes as a protective measure for Hilsa were finally abandoned, and for the preservation of the species the proposal for the construction of a Hilsa hatchery at the Lower Anicut on the Coleroon River was adopted instead. In a recent contribution on "Fish Ladders in the Punjab"[1] Dr. Hamid Khan has concluded that

> "Most of the fish ladders in the Punjab are ineffective and their main defects are:—(*i*) the majority of them are too steep and too narrow; (*ii*) the upstream inlets are generally too severe to allow the smaller species of the migratory fish to ascend; (*iii*) the downstream openings in most cases are too small, and therefore too inconspicuous to be perceived by the ascending fish, that is to say, the fish ladders are not self-advertising; (*iv*) there is hardly any pool at the entrance of the ladders where fish could collect before ascending; (*v*) the water supply in the ladders is not available during the periods when the fish migrate; and finally (*vi*) the majority of them are not fish ladders but mere fish traps for catching fish.
>
> "The effect of inefficient fish ladders in the Punjab is beginning to be felt in the higher reaches of the rivers and there seems to be no doubt that as a result of it the stock of fish in the Punjab rivers has decreased very considerably during the last fifteen or twenty years."

The effect of placing permanent or semi-permanent wiers across streams on the population of migratory fishes, such as *Mahseer*, was also referred to by Hora and Mukerji[2] in the course of their studies on the fish of the Eastern Doons.

It is a matter of considerable interest, therefore, to know that the Western Division of the American Society of Ichthyologists and Herpetologists, and the Western Society of Naturalists jointly held a symposium at the Stanford University on June 29, 1939, under the Chairmanship of Dr. F. B. Summer on "Dams and the Problem of Migratory Fishes". The detailed report of the symposium, which has now been published in a special issue of the *Stanford Ichthyological Bulletin*,[3] contains valuable information on all aspects of the problem. It is worthy of special note that all the members taking part in the symposium were, from experience, training and first-hand knowledge of fishes, best able to deal with the problems that were discussed. Dr. Willis H. Rich, who discussed 'Fishery Problems Raised by the Development of Water Resources' is now Professor of Biology at Stanford University and Director of the Department of Research of the Fish Commission of Oregon. Dr. Rich was in charge of the Division of Scientific Inquiry of the U.S. Bureau of Fisheries, 1922–26, and was Chief of the Bureau's Salmon Investigations, 1926–30. During his service with the Bureau, he directed very extensive marking and tagging experiments upon salmon. Mr. Harlan B. Holmes, who read a paper on "The Passage of Fish at Vonneville Dam", was Aquatic Biologist of the U.S. Bureau of Fisheries for several years, but was later assigned to the U.S. Army Engineers. In this capacity, he was the man who planned and saw to completion the gigantic fishways of the Bonneville Dam. Mr. Holmes also participated in some of the basic experiments upon salmon migration, in co-operation with Dr. Gilbert and Dr. Rich. Dr. Wilbert McLeod Chapman, who narrated "Fish Problems connected with the Grand Coulee Dam", was Scientific Assistant with the International Fisheries Commission at Seattle, and is now in charge of the fisheries investigations being made relative to the Grand Coulee Dam by the Department of Fisheries of the State of Washington. He has carried on extensive studies of the anatomy, physiology and

taxonomy of fishes, as well as matters more directly related to the fisheries. Dr. Harry A. Hanson, who presented "Preliminary Report on an Investigation to Determine Possible Methods of Salvaging the Sacramento River Salmon and Steelhead Trout at Shasta Dam" has been Scientific Assistant with the International Fisheries Commission at Seattle, later Assistant Chief of the Division of Scientific Inquiry of the U.S. Bureau of Fisheries. He is now chief of an investigation party of the U.S. Bureau of Reclamation, investigating the Sacramento River salmon. In this position he is in direct charge of fisheries investigations at the Shasta Dam. Dr. A. C. Taft, who gave "A Summary of the Present Status of Dams *versus* Migratory Fishes on the Pacific Coast with Especial Reference to Problems in California" is the Chief, Bureau of Fish Conservation, California Division of Fish and Game, was for a number of years Aquatic Biologist of the U.S. Bureau of Fisheries engaged in salmon and trout studies in Alaska and California. In the course of these studies he conducted various marking experiments on both Pacific salmon and steelhead trout.

In the discussion that followed the presentation of various papers in this symposium several points of interest were brought out, and finally the following Resolution was adopted:—

"The Western Division of the American Society of Ichthyologists and Herpetrologists and the Western Society of Naturalists, being assembled at Stanford University, California, at this annual meeting and having considered in considerable detail the effects of dam construction in west coast waters and their incident and usually harmful effect on migratory fishes such as salmon and steelhead trout, hereby offer the following resolution to be presented to the various Federal and State Agencies, National Resources Committee, Western States Planning Boards, Water Resources Committees, and other bodies concerned with water planning programs:

"Whereas construction of the Bonneville and Grand Coulee Dams on the Columbia River in Oregon and Washington, the Shasta Dam on the Upper Sacramento River in California, and other such Federal and State projects has, and will continue to, greatly jeopardize the continued productivity of salmon and steelhead trout to the people of West Coast States, and

"Whereas actual construction work on each of these dams has, almost without exception, been begun without sufficient advance consideration of the effects of the proposed structures on salmon and trout, therefore

"Be it resolved: that fisheries resources be given consideration equivalent to that given all other water uses by Federal and State Planning or Construction Agencies and that before starting construction of any dam or other type of structure proposed in any basin containing salmon or steelhead trout, surveys of the fisheries resources be made by qualified experts, to parallel engineering surveys, over a minimum period of five years, or sufficient to cover the life-cycles of all economically important fishes concerned."

The above resolution directs pointed attention to a matter of very grave importance to the fisheries of the United States of America. In India also more extensive measures are now being adopted to harness the water resources of the country for purposes of irrigation, generation of electric power and in connection with various industries. Though no one doubts the great utility of these projects, due consideration must also be paid to the conservation of the fisheries, and this is of particular importance in connection with the provision of proper water channels for the migration of fishes, and the prevention of the pollution of the streams. Here reference may be made to a very appropriate quotation from Veblen (*The Instinct of Workmanship*) given on the last page of the Symposium Number in which it is stated that

"Virtually all thoughtful persons will agree that it is a despicably inhuman thing for the current generation wilfully to make the way of life harder for the next generation, whether through neglect of due provision for their subsistence and proper training or through wasting their heritage of resources and opportunity by improvident greed and indolence."

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[1] *Bombay Nat. Hist. Soc.*, 1940, **41**, 551.

[2] *Rec. Ind. Mus.*, 1936, **38**, 135.

[3] 1940, **1**, 173.

OBITUARY

SIR J. J. THOMSON (1856–1940)

In the demise of Sir Joseph John Thomson, on the morning of 30th August, the world has lost a great and distinguished leader of science, whose pioneering work blazed itself across the scientific firmament of the last quarter of the 19th and the first decade of the present century. Born on December 18, 1856, his earlier education was at Owen's College, Manchester, and Trinity College, Cambridge. He was elected to the Fellowship of the Royal Society in 1884, and during the same year called to the chair of Cavendish Professorship. For thirty-five years he filled this chair with great distinction, and organised the Research laboratories which soon became the Mecca of physicists all the world over. He was elected to the presidentship of the Royal Society during 1916 to 1920, and was the recepient of almost all the distinctions which the scientific world could bestow on one of its greatest devotees.

Sir J. J. Thomson's remarkable achievement lay in the realm of the electronic constitution of matter. His classical and ingeniously devised experiments on the discharge of electricity through gases were crowned with the brilliant discovery of the corpuscular nature of the cathode rays, the particles constituting these rays having a mass two thousandth of that of the hydrogen atom. It was this discovery, supported by other significant and almost simultaneous investigations of Zeeman and Lorentz in Holland and Lenard in Germany, that helped to firmly establish the electronic theory of matter.

Besides his numerous papers in *The Proceedings of the Royal Society* and the *Philosophical Magazine*, Sir J. J., as he came to be called affectionately in later years, was the author of a number of well-known books, the most famous of which are on the conduction of electricity through gases, and a series of general text-books on Physics, written in collaboration with Prof. Poynting.

Sir J. J. was the leader of a very active school of Physics. More than twenty-five of his students have been elected to the Fellowship of the Royal Society, and six of them for the award of the Nobel Prize. He retired from the Cavendish chair soon after the last World War, and was succeeded by Lord Rutherford. It was an appropriate tribute that was paid to the abounding energy of Sir J. J., when the late Lord Rutherford referred to him at a dinner party given to celebrate his eightieth birthday, as "A star of the first magnitude, a central sun that does not shrink with age, but draws on some unknown source of energy".

INTELLIGENCE SERVICE FOR INDUSTRIAL RESEARCH

At a conference of chemists, called by the **Indian Munitions Board** at Lahore on the 8th January 1918, it was agreed that (1) a monthly list of researches in progress should be circulated to all chemists who are assisting the Board with Research work, (2) at the foot of the list, a list of problems awaiting investigation should be published and (3) chemists undertaking research work for the Board should be requested to inform the Board of any problems that may occur to them.

To-day, the Government of India has inaugurated the Board of Scientific and Industrial Research which has already taken the initiative in launching a number of research schemes of immediate practical interest.

A periodical (monthly) publication of the list of researches together with any important achievements made in each of the lines would be helpful in many different ways. The research worker will be enabled to keep himself informed of the various lines of industrial work pursued in the country and wasteful duplication could be avoided. The publication will further be helpful for the research worker to get into touch with his colleagues who may be working in a closely allied line. The several provincial and State governments, the industrial magnates and the interested public will have an opportunity of keeping themselves informed of the progress of industrial research in the country.

We earnestly hope that the Board of Scientific and Industrial Research will consider the advisability of publishing the list of researches and reporting upon their progress from time to time.

LETTERS TO THE EDITOR

Effect of Crystal Orientation on the Raman Spectrum of Calcite

Results of detailed investigations relating to the effect of orientation on the Raman spectra in crystals have been published by Nedungadi[1] and by Bhagavantam.[2] Some of their results which are considered to be anomalous are given in Table I.

Table I

Direction of vibration of incident light along	Orientation of the optic axis along	Relative intensities of components of Raman lines: 1065 ($NaNO_3$) Nedungadi, OX	1065 ($NaNO_3$) Nedungadi, OZ	1084 ($CaCO_3$) Bhagavantam, OX	1084 ($CaCO_3$) Bhagavantam, OZ
OY	OX	0	**59**	2	5
OZ	OY	**13**	100	**60**	100
OY	OY	**10**	0	**50**	5

All components which are printed in heavy type should not have appeared at all, as the theory predicts zero intensities for such orientations. Nedungadi recognised this in the case of $NaNO_3$ and classified them as definitely anomalous. Results, subsequently obtained by one of the present authors, in the analogous case of calcite showed that there was no difficulty with regard to the orientation corresponding to the first row of Table I, but that the anomaly in respect of the orientations defined by the second and the third rows is even more prominent in this case.

In view of the importance of these results and in view of the fact that such discrepancies between theory and experiment, if true, would necessitate a revision of the fundamental notions underlying the theory of light scattering by crystals, we have undertaken a very detailed and careful study of this problem. After a series of investigations, it was concluded that for obtaining proper results in these cases, very stringent conditions of polarization, collimation and instrument correction have to be employed. The use of a wide angle condenser, a polaroid and an improperly collimated arrangement on the side of the spectrograph have been found to be responsible for the

errors in the previous investigations. In the present investigation, slits have been used to limit the convergence in the incident beam, the polaroid has been replaced by a nicol prism as the imperfection of polarization introduced by the polaroid has been found to be quite serious and the collimation on the side of the spectrograph has been performed very carefully and with special reference to the correction introduced by the instrument due to oblique refraction. In this way, the intensities of the OX components of the 1084 line in calcite when the crystal is oriented in accordance with the second and the third rows of Table I, have been reduced to negligible proportions. We, accordingly, conclude that the experimental results in calcite are in full agreement with what may be expected of such a crystal. Most probably, the corresponding OX components in the case of $NaNO_3$ also will behave similarly under improved conditions of experimentation.

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B. POORNACHANDRA RAO.
Department of Physics,
Andhra University,
Waltair,
September 9, 1940.

1 *Proc. Ind. Acad. Sci.*, 1939, **10**, 197.
2 *Ibid.*, 1940, **11**, 62.

On the Weights of Old Indian Punch-Marked Coins

IN continuation of the work on punch-marked coins published in the July issue of *Current Science*,[1] I have the following announcements to make:—

1. The weight variances of the Mauryan period are much greater than those of the earlier period, at least on the evidence of coins found at Taxila. For the later hoard, which is in almost mint condition, the variance is, in grain units, 5·65, whereas the variance for all the coins of the earlier hoard is 1·49, and for single groups of coins in the hoard, as low as 0·14, which compares favourably even with modern machine-struck coins.

2. Proceeding on the assumptions that Walsh's descriptions[2] are substantially correct, and that my analysis (which makes the reverse marks periodic and regular checking marks) acceptable, it is found possible to arrange the main and most important groups of coins in the earlier hoard, in chronological order. These are: B.b.1, A.1, C.1, D.2, in Walsh's notation. The problem of assigning them to kings or dynasties is difficult on the basis of extraordinarily conflicting documentary evidence. But, as a tentative effort, I associate these coins in order with: Śiśunāga II; the (later) Śaiśunāgas; the Nandī or Nanda dynasty; and the Nava (= new, not nine) Nanda, Mahāpadma, who is to be taken as the immediate predecessor of Candragupta Maurya. The documents used are Pargiter's excellent collation of Puranic texts, the *Aryamañjuśrīmūlakalpa*, the *Mahāvaṃso*, the *Samantapāsādikā* and its Chinese translation, and some of the Jain tradition as reported in the encyclopædia, *Abhidhānarājendra*. It is, of course, quite possible to give different interpretation and weightage to these texts, and to reconcile their great divergences in a different way.

3. The coin samples are invariably skew-negative; and sometimes platykurtic because of a few badly underweight specimens which could be discarded by a certain criterion, based on the variance of the group itself, which I have had to use in the absence of any other evidence. But the skewness will always remain, and is in fact to be expected. The question now arises, does the z test apply to such distributions? If we assume that the frequency (probability) function has an expansion in weighted Hermitian polynomials about the mean value (surely not too restrictive an assumption), it is easily seen that *a sufficient condition for the distribution of the variance to remain the same as for a normal distribution is that all terms of even order, except of course the constant term, should be absent from the expansion.* This also ensures that all even order moments are the same as for a normal distribution. So, it is clear that all

tests based on variance alone—which excludes the t test, but allows the z test, Behrens's test, and others of the sort—are valid for a skew distribution provided there is no kurtosis. But it must be noted that these variances are to be taken about the, usually unknown, true or population mean; otherwise, the z test for skew populations is only a very good approximation for all but the smallest samples.

D. D. KOSAMBI.

Fergusson College,
Poona,
September 6, 1940.

[1] *Curr. Sci.*, 1940, **9**, 312.
[2] *Archæological Survey of India, Memoir* No. 59.

An Empirical Statistical Formula

FOR moderately asymmetrical distributions the empirical relation:

$$\text{Mean} - \text{Mode} = 3(\text{Mean} - \text{Median})$$

seems to hold good with a surprising degree of precision. In 1895, Karl Pearson proved the approximation for the Type III curve and in 1917, Doodson gave a proof for more general types of frequency distributions. But the simplest case of the triangular distribution defies the law in a remarkable manner not apparently noticed before, probably because of the artificiality of this case. It may be worth while to note the following facts, at least on account of their suggestiveness of other possible distributions where the law may be wholly denied:

(1) For a triangular frequency distribution,

$$4 \leq \frac{\text{Mean} - \text{Mode}}{\text{Mean} - \text{Median}} \leq 4 + 3\sqrt{2} \approx 8\tfrac{1}{4}.$$

(2) The greatest value $4 + 3\sqrt{2}$ occurs for a finite linear distribution starting from 0, and also for an infinite triangular distribution.

(3) The least value 4 corresponds, paradoxically, to the isosceles triangle distribution, for which all the three measures of location coincide and the ratio therefore takes an indeterminate form with the limiting value 4.

(4) The ratio of the differences (mean, mode) and (mean, median) is a homogeneous fractional function of the ranges to the right and left of the mode.

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Mysore,
August 23, 1940.

[1] *Philosophical Transactions*, 1895, **186 A**, Pt. I, 343.
[2] *Biometrica*, 1917, **11**, 425.
[3] *The Annals of Mathematical Statistics*, 1938, **9**, 176.

Mechanism of Swelling of Cellulose

WHILE studying the swelling of cellulose in aqueous solutions of neutral salts, $ZnCl_2$, $Ca(CNS)_2$, $Zn(CNS)_2$ and of mineral acids HCl, HNO_3, H_2SO_4 and H_3PO_4, following observations were made.[1] With both the salt and acid solutions, when solutions are dilute there is a preferential absorption of the solute. This is distinctly noticeable until the concentration of the solution reaches values that cause high swelling. Further, there is a distinct preferential absorption of the cation of the salt at low concentrations of salt solutions and also in the initial stages of swelling in high concentrations. Neale[2] who made an exhaustive study of swelling of cellulose in NaOH made similar observations and concluded that swelling is caused by the initial formation of a sodium salt of cellulose, which then ionises giving a diffusible hydrogen ion and a non-diffusible cellulose ion, the principle of the Donnan equilibrium being applicable to such a system. The acidic nature of the cellulose suggests the possibility of the formation of zinc and calcium salts of cellulose, although such a reaction is out of question between cellulose and mineral acids.

It is also observed that swelling in these solutions is accompanied by the formation of hydrocellulose. This has been confirmed by measuring the fluidity, copper number and the dye absorption of the original cellulose and of the swollen material.

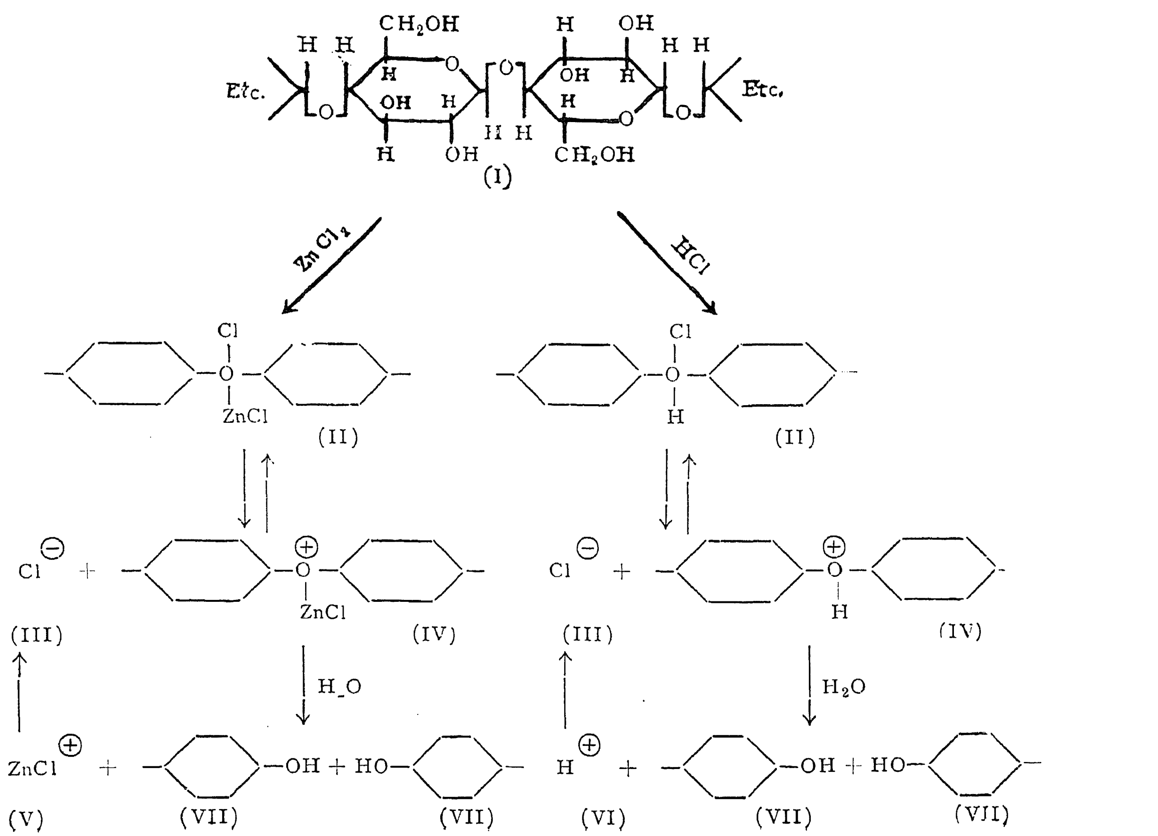
These results suggest the formation of some cellulose-salt or cellulose-acid complex of a type which results firstly in causing the swelling of the material and secondly in its degradation,

A consideration of the constitution of cellulose throws light on the nature of such complexes. Cellulose molecules consist of a large number of glucose units linked to each other through oxygen bridges. The oxygen atoms which form the glucoside linkage are divalent and by analogy with similar other organic compounds are, in all probability, capable of functioning as tetravalent atoms and forming oxonium salts with inorganic salts and acids. The work of Walker,[3] Knox and Richards[4] and of Baeyer and Villiger[5] indicates that the formation of oxonium salts with cellulose is distinctly possible. It is therefore suggested that the first stage in the swelling of cellulose is its formation of oxonium salts with salts and acids.

The following represents the changes which are suggested as taking place in the order in which they are presented.

The cellulose molecule (I) combines with the neutral salt or the acid to give the corresponding oxonium salt (II). It is further suggested that these oxonium salts in solution ionise and give rise to a diffusible anion (III) and to a non-diffusible 'oxonium cellulose cation' (IV) and thus create conditions which set up an osmotic flow of the external liquid into the gel phase in accordance with the principle of the Donnan equilibrium. This results in the swelling of cellulose.

The degradation of cellulose, which results in a shortening of its chain length and in the increase of the number of reducing end groups, can also be explained on the basis of the formation of oxonium salts and their subsequent ionisation. The non-diffusible 'cellulose oxonium cation' (IV) further reacts with a molecule of water and liberates the cations (V or VI) and simultaneously severs the glucoside link giving cellulose molecules (VII) of a shorter chain length. The cation from the salt or the acid bound to the cellulose is thus set free to combine with the anion formed at an earlier stage. This mechanism would also account for the hydrolysis of cellulose by acid or salt catalysis. The process of hydrolysis being a



slow one, it is obvious that "oxonium cellulose cation" will react with a water molecule only after an appreciable time. The formation of the oxonium compound, its ionisation, etc., would also account for the decrease in the 'ζ' potential with time in acid and salt solutions observed by Briggs.[6]

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July 30, 1940.

[1] G. S. Kasbekar, *Ph.D. Thesis*, 1938, Manchester University.
[2] Neale, *J. Text. Inst.*, 1929, **20** T., 373–400.
[3] Walker, *J. Chem. Soc.*, 1904, **85**, 1105.
[4] Knox and Richards, *Ibid.*, 1919, **115**, 508.
[5] Bayer and Villiger, *Ber.*, 1901, **34**, 2679.
[6] Briggs, *J. Phys. Chem.*, 1928, **32**, 1646–62.

The Milk-Clotting Activity of Papain

It has already been shown that the gelatin splitting activity of papain is not impaired by oxidation of the fresh latex of papaya by hydrogen peroxide or alloxan; only the peptone hydrolysing activity is lost.[1] It has now been shown that the milk-clotting property of papain is also lost through oxidation with hydrogen peroxide or other oxidising agents.

Hydrogen peroxide-inactivated papain regains its milk-clotting property on reduction with cyanide or H_2S; as in the case of peptonase, this activity is inhibited by maleic acid (the inhibition being a time reaction), and the copper inhibition is annulled by cyanide. Iodoacetic acid irreversibly inactivates the enzyme. The press juice of pine apple and the latex of *Calatropis gigantea* behave exactly like papaya latex with respect to the milk-clotting activity. The minimum amount of iodoacetic acid required to arrest the milk-clotting properties of the papaya latex extract and pine apple press-juice of the same activity, is the same.

The changes in milk clotting activity brought about by treatment with different reagents are tabulated below.

Milk-clotting Activities of Papainases

(Figures indicate time in seconds required for clotting milk prepared from *klim*—5 c.c. of 10 per cent. in acetate buffer, pH 4·6 ; enzyme solution diluted with water or reagent : 0·5 c.c. ; temperature 40° C.)

Enzyme	Water extract	H_2O_2 treated	H_2O_2 treated + HCN	Copper 0·01 mg.	Maleic acid 5·8 mg.	Iodoacetic acid 0·01 mg.
Papain : latex extract 1 %	15	> 1 hr.	200	200	190	> 1 hr.
Pine apple press juice diluted with an equal volume of water	30	> 1 hr.	250	300	..	> 1 hr.
Calatropis gigantia latex extract 2 %	15	> 1 hr.	250	250	..	> 1 hr.

Balls and co-workers[2] observed that while preparing papain conditions which did not preclude oxidation always yielded preparations with low milk-clotting activity. This suggests that the milk-clotting activity is associated with a labile group and the observation reported above renders probable the assumption that this group is the SH group.

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July 5, 1940.

[1] Ganapathy and Sastri, *Biochem. J.*, 1939, **33**, 1175.
[2] Balls and Lineweaver. *J. Biol. Chem.*, 1939, **130**, 669.

On *Orbitosiphon*, A New Genus of Orbitoidal Foraminifera from the Ranikot Beds of the Punjab Salt Range (N.W. India)

IN 1937, Lt.-Col. L. M. Davies[1] described under the name *Lepidocyclina* (*Polylepidina*) *punjabensis*, a new orbitoid from the Ranikct (Paleocene) beds of the Salt Range. He seems to have been in some doubt regarding the systematic position of this fossil and mainly relying on the supposed occurrence of a multilocular nucleoconch, he refers it to the sub-genus *Polylepidina*. Since the lowest horizon in N.W. India from which the genus *Lepidocyclina* has been recorded with complete certainty is the Nari (Oligocene), a further critical study of the Ranikot orbitoid seemed necessary to make sure about the correctness of its reference to the sub-genus *Polylepidina*. This has now been done with the help of specimens which were kindly sent to me by Mr. W. D. Gill (Paleontologist, Attock Oil Co., Rawalpindi) from the type locality in N.W. India.

There are fundamental structural differences between the Salt Range orbitoid and the sub-genus *Polylepidina* as defined by Dr. T. W. Vaughan,[2] and these differences are summarised in the following tabular statement:

In view of these considerations, the reference of the Salt Range orbitoid to the sub-genus *Polylepidina* is evidently untenable. Since the arrangement of the chambers of the embryonic apparatus noticed in this fossil as described

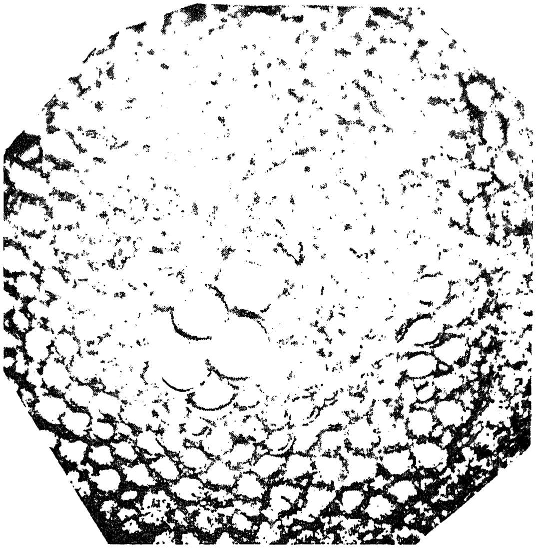


FIG. 1

Orbitosiphon sp. gen. nov. (= *Polylepidina punjabensis* Davies).

Equatorial section. × 60. Loc.—In Khairabad limestone.

Dhak Pass, Salt Range.

L. (*Polylepidina*) *punjabensis* Davies	*L.* (*Polylepidina*) Vaughan
(1) Equatorial chambers arranged in intersecting arcs.	Equatorial chambers arranged in radiating rows.
(2) Equatorial chambers are all nearly of the same dimension; radial and transverse diameter of each chamber about the same.	Equatorial chambers gradually increase in size from the centre to the periphery; transverse diameter about twice the radial.
(3) The megalospheric embryonic apparatus consists of a bilocular nucleoconch with a large spherical chamber followed by a smaller one; the initial chambers are completely enveloped by a whorl of 10 peri-embryonic chambers which are of unequal sizes and are subspherical to arcuate in shape. The peri-embryonic chambers are disposed symmetrically around the nucleoconch.	The megalospheric embryonic apparatus consists of 4-5 chambers irregularly arranged.

above, is not found in any other genus of the Orbitoididæ, it seems necessary to erect a new genus to include this form. I propose the name *Orbitosiphon* for this new genus.

S. R. NARAYANA RAO.

Department of Geology,
University of Mysore,
September 3, 1940.

1 *Pal. Ind.*, n.s., 1937, **24**, Mem. No. 1, 52.
2 *Proc. Nat. Acad. Sci.*, Washington, 1929, **15**, 288.

On the Association of the Orbitoidal Genera *Discocyclina* and *Lepidocyclina* in the Yaw Stage (Priabonian) of Burma

IN 1907, Vredenburg[1] summarised the known facts regarding the distribution of the genera *Discocyclina* and *Lepidocyclina* in the Indian region as follows:

> "*Orthophragmina*[2] and *Lepidocyclina* have never been found together ...... In almost every section, *Orthophragmina* occurs up to the top of the Eocene, and *Lepidocyclina* from the very base of the Oligocene so far as these series are developed ...... In countries where the intervening stages are better developed, it is quite possible that one may observe an association of the two genera *Orthophragmina* and *Lepidocyclina*: if at any place the first appearance of *Lepidocyclina* preceded the final extinction of *Orthophragmina,* both genera might naturally be found in the same bed."

In contrast with N.W. India, where beds of Priabonian age have not been so far recognised, the Eocene-Oligocene succession of Burma is more continuous and the Priabonian horizon is represented by marine fossiliferous beds of the Yaw stage. Recently, while examining a collection of foraminifera[3] from these beds, I have noticed the occurrence of two orbitoids which have so far not been recorded from these beds. These are: a *Lepidocyclina* of the sub-genus *Polylepidina* and a stellate *Discocyclina* of the sub-genus *Asterocyclina*. The discovery of these two orbitoids from the Yaw stage of Burma is of considerable interest in view of the fact that no well authenticated record of the association of these two genera in the same bed has so far been reported in the Indian

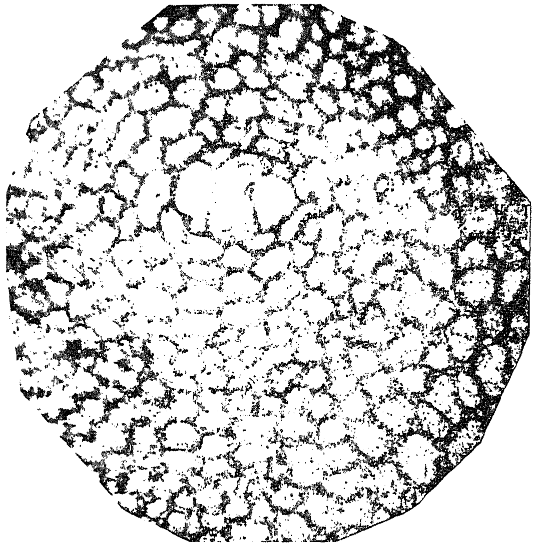


FIG. 1

Lepidocyclina (Polylepidina) sp. Equatorial section × 48. Loc.—From Yaw shales, near Yesain, Pakokku District, Burma.

FIG. 2

Discocyclina (Asterocyclina) sp. Equatorial section showing structure of the '*Pseudophragmina*-type'. ×15. Loc.—Same as for Fig. 1.

region, though the possibility of discovering such an association was anticipated by Vredenburg so far back as 1907. The present record is also important in extending the range of the

genus *Lepidocyclina* down to the Upper Eocene (Priabonian) in the Indian region.

S. R. NARAYANA RAO.
Department of Geology,
University of Mysore,
September 3, 1940.

[1] *Rec. Geol. Surv. Ind.*, 1907, **35**, 66.
[2] *Orthophragmina* is a typonym of *Discocyclina*.
[3] I am indebted to the Director, Geological Survey of India, for the material and for kind permission to publish this note.

A Note on the Morphology and Chromosome Number of *Litchi chinensis* Sonner

Litchi chinensis is one of the important fruit trees of India. It is cultivated extensively in Behar and Bengal. In 1929 Abdur Rahaman Khan[1] published an account on the pollination and fruit formation in litchi (*Nephelium litchi* Camb.). In this he has given an account of the occurrence of different types of flowers in the panicle as also the periodicity of flowering of the plant. Since then no other important contribution has appeared on the morphology or cytology of the plant.

The present note gives a preliminary account of the results of observations that have been made during the last two seasons. It is proposed to extend the investigations and to publish a fuller account of it in due course.

The author's observations agree in general with those of Khan regarding the nature of the panicle and the types of flowers produced. The cymes, however, were found to bear both "Male" and "Female" flowers during the transition stage. Distinct periodicity of flowering has been noted in different plants. The limits of the flowering period may or may not overlap. Observations made so far indicate that there may be two to five stages of flowering ("Flushes").

The different floral parts develop in the following sequence: calyx, andrœcium and gynæcium. A gynophore is present and a fleshy disc occurs between the calyx and the andrœcium. The so-called "Male" flowers show normal meiotic process and the haploid number of chromosomes has been determined to be fourteen ($n = 14$). A pistillode is present in these flowers, inside which normally developed ovules with integuments are noted but always in a collapsed or shrivelled condition. In the "Female" flowers the filaments of the anthers are very short and perfect pollen grains are produced as a result of normal meiotic process, but the pollen grains are not liberated from the microsporangium due to the non-dehiscence of the anthers. The pollen grains of the "Male" flowers are binucleate at the time they are shed. The pollen grains of both types of flowers are morphologically similar in shape and size and are also viable.

The development of the female gametophyte is of the normal type and a normal eight-nucleate embryo-sac is produced.

The aril arises from two different primordia which develop from the funicle and from the outermost cells of the outer integument. The products of these primordia get fused for a considerable length upwards from the base of the seed, but remain free at the top where they overlap. The fruit shows three distinct layers. The tubercles develop from the epicarp.

My thanks are due to Mr. I. Banerji under whose guidance the investigation is being carried out.

KANTILAL CHAUDHURI.
Department of Botany,
Calcutta University,
September 4, 1940.

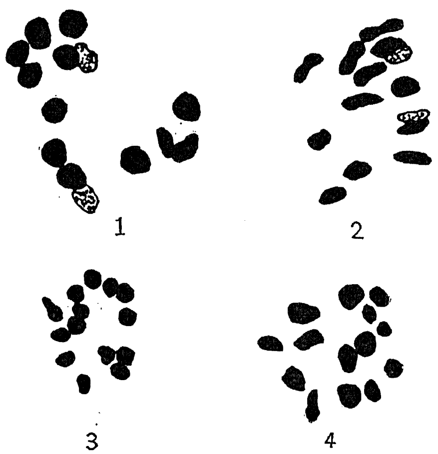
[1] Khan, Abdur Rahaman, *Agri. J. of India*, 1929, 183.

A Note on the Chromosome Numbers of Cassia

In the present note the writer desires to briefly describe his observations on the chromosome numbers of *Cassia occidentalis* L. and *C. auriculata* L. The first species is widely distributed throughout this country and extends

to all tropical countries, while the second is found in C.P., S. India and Ceylon. The material on which the present observations are based was collected from plants growing wild at Waltair, close to the laboratories of the Andhra University and the chromosome counts have been made from permanent smears of pollen-mother cells fixed in Nawaschin and stained with Iodine, Gentian Violet.

The first report on the chromosome numbers of *Cassia occidentalis* was made by Muto.[1] He found the haploid chromosome number to be 13. Senn,[2] however, contradicts his observations and reports $14n$ chromosomes. My observations on Waltair plants have also revealed $n = 14$ (Fig. 4). Muto's observations thus appear to be incorrect unless the material he studied belongs to some aneuploid variety. A similar discrepancy between the observations of different workers is seen also in *C. tora*. Datta[3] and Senn[2] report the chromosome number as $n = 13$, but Jacob[4] has observed 28 diploid chromosomes in the root tip cells. He explains the difference by suggesting that it may be due to occasional quadrivalent formation during meiosis.



Figs. 1–3.—*Cassia auriculata*. Figs. 1 and 2—I Metaphase. Fig. 3. II Metaphase Fig. 4.—*Cassia occidentalis*, II Metaphase. × 2,700.

The chromosome numbers in *C. auriculata* are more interesting. Jacob[4] has observed in material obtained from Ceylon that there are two types of plants, one with the chromosome number $2n = 14$ and the other with $2n = 16$. In the material from Waltair the writer has found the chromosome number to be $n = 14$ (Figs. 1–3). These plants are thus tetraploid when compared with the Ceylon plants. That these should come from a more northern latitude than the diploid plants apparently supports the views of Hagerup,[5] Tischler,[6] etc., on cytoecology, but clearly a more detailed geographical study is necessary to draw definite conclusions. Polyploidy within a species of *Cassia* has been previously observed in *C. mimosoides* by Kawakami[7] who found plants with $n = 8$, 16 and 24. *C. auriculata*, however, is remarkable for showing both polyploidy and aneuploidy within the species.

The writer is indebted to Dr. A. C. Joshi for help in the preparation of this note and to Mr. J. Venkateswarlu of Andhra University for much help in the collection of the material and verifying the identification of the plants.

J. V. Pantulu.

Benares Hindu University,
Benares,
August 22, 1940.

1 Muto, A., *Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B.*, 1929, **4**, 265.
2 Senn, H. A., *Bibliographia Genetica*, 1938, **12**, **175.**
3 Dutta, R. M., *Jour. Ind. Bot. Soc.*, 1933, **13**, 277.
4 Jocob, K. T., *Ann. Bot., N. S.*, 1940, **4**, 201.
5 Hagerup, O., *Hereditas*, 1932, **16**, 19.
6 Tischler, G., *Jour. Ind. Bot. Soc.*, 1937, **16**, 165.
7 Kavakami, J., *Bot. Mag. Tokyo*, 1930, **44**, 319.

Rain and the Atmospheric Electric Field

I was much interested in the note published in the August number of *Current Science* by Mr. A. R. Pillai on the Changes of Atmospheric Electric Potential Gradient during Monsoon Rains in Bombay. May I draw the attention of your readers to a paper published by me in the September 1930 number of *Terrestrial Magnetism and Atmospheric Electricity* on "The Influence of Rain on the Atmospheric Electric Field". The paper is abstracted in *Science Abstracts*.[1] I have shown in the paper that, as a rule, a sharp drop and a reversal of the

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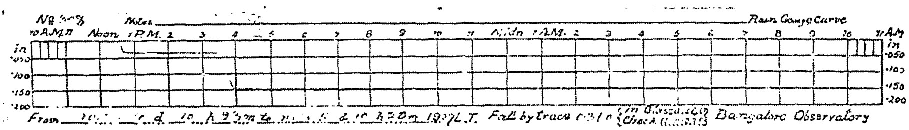
4–5 Nov., '27



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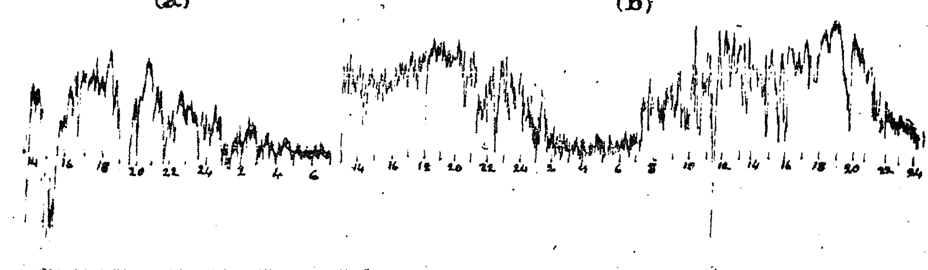
(a) 19–20 July, 1928

(b) 24–26 Dec., 1928

(a) (b)



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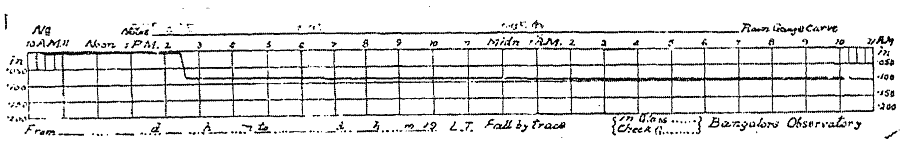

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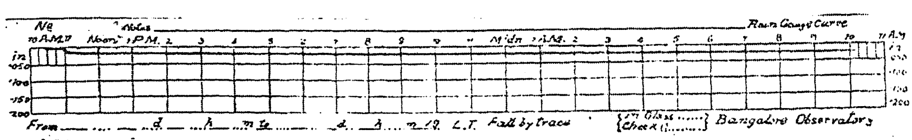
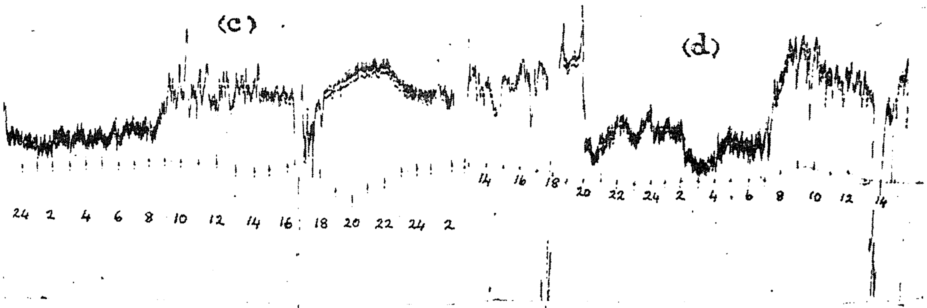


(c) 6 Oct., 1929

(d) 7-9 Oct., 1929



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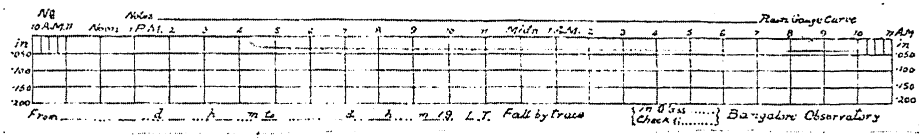

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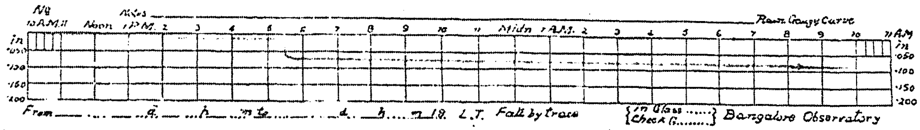

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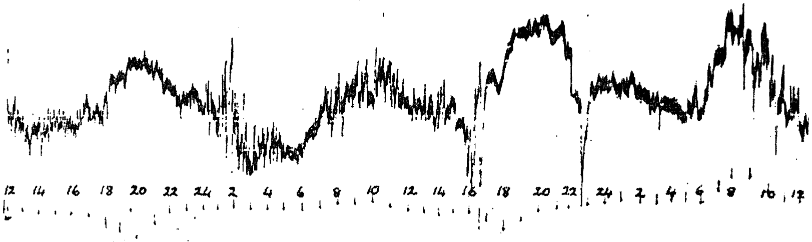
11-13 Nov., '29



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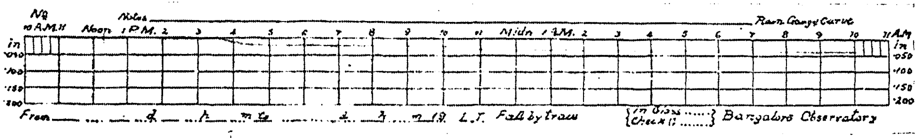
12-13 Nov., '29



normal positive field accompanies showers of rain, however small, and offered an explanation of this phenomenon. The explanation does not preclude, in fact it predicts, a very few cases when the field would be enhanced owing to negative charge being brought down by the rain in the early stages, a comparatively rare occurrence. The explanation also covers the observed wide fluctuations of field during periods of continuous or heavy rain.

A. VENKAT RAO TELANG.

Central College,
Bangalore,
August 28, 1940.

[1] *Sec. A*, 1931, **34**, Abs. No. 580.

MIXTURES OF STAPLE FIBRE AND INDIAN COTTONS

WITH the comparatively recent development of staple fibre—cut filaments of specified length, diameter and denier—with its capacity of being spun pure or blended with cotton, wool, etc., on the existing machinery, the textile industry has been offered an excellent material for producing an almost unlimited variety of yarns with novel characteristics. It has, for instance, been used in the manufacture of fancy plyed or crepe yarn, in hosiery goods, in union fabrics in which contrast effects have been produced, in imitation of light worsteds, etc. The demand for these fibres has been increasing so fast that within the last decade, their world consumption has risen from a bare 9 million to over 1,000 million pounds. The Indian mills are evincing considerable interest in this new material and the wide possibilities it opens up for producing novel and attractive fabrics when mixed with cotton. It was, therefore, decided to study the spinning quality of mixtures of Indian cottons with suitable staple fibres at the Technological Laboratory of the *Indian Central Cotton Committee*. Some preliminary work done at the Laboratory gave interesting results which were published in a bulletin. It was decided to follow up this work by a more detailed study, especially of the optimum conditions for spinning mixtures of staple fibre—1·00″ and 1·5 denier, with three Indian cottons, Jayawant, Cambodia Co.2 and Surat 1027 A.L.F. in which the proportions of staple fibre were 10, 15, 20 and 30 per cents. The pure staple fibre, the cottons and their mixtures were spun with different twist multipliers and drafts in order to investigate the effect of these important factors on the spinning behaviour of the material and the quality of the yarns.

The cottons and staple fibre were tested for their fibre properties, length, weight, diameter, clinging power, and dry and wet strength. The spun yarns were tested for twist, lea, dry and wet, single thread and ballistic, strengths. A number of interesting results have been obtained. It has, for instance, been found that higher twists and larger proportions of staple fibre tend to reduce the dry yarn strength, while with lower twists the addition of staple fibre upto 20 per cent. improves the yarn strength. The wet strength decreases progressively with increase in the proportion of staple fibre in the mixtures, while the elasticity of the yarn increases. For the lower proportions of staple fibre, the dry strength is very nearly equal to the wet strength, while the wet count work product is always higher than the dry count work product.

Full details of this work will be published as a bulletin.

REVIEWS

The Tools of the Chemist. By Ernest Child. (Reinhold Publishing Corporation, New York; Chapman & Hall, London), 1940. Pp. 220. Price 21*sh*.

This book outlines a branch of historical research which has not hitherto received adequate attention. It is a very successful attempt to trace the birth and growth of the chemical apparatus industry in the United States.

Students of eighteenth and early nineteenth century chemistry must always feel amazement at the skill and ingenuity with which its exponents devised and utilised appliances which appear so clumsy to us; but it is doubtful whether this emotion has engendered an appropriate gratitude towards the modern apparatus-producer. Among a hundred chemists able to describe the researches of Gay-Lussac, how many are aware that he founded with Collardeau a firm for manufacturing the apparatus he invented? How many could focus Frederick Accum, one of the early dealers in apparatus, who designed and improved philosophical "glasses", and emulated Sir Humphry Davy as a chemistry propagandist? Yet our obligation to the mute, inglorious glass-blower is incalculable.

Mr. Child's book is in three parts, namely, People and events in American Chemistry, Ancestry and development of American chemical apparatus, and Distributors of laboratory apparatus. Upwards of 100 illustrations including portraits enliven the pages, and the enterprise, which must have involved enormous labour here condensed within a narrow compass is timely because each year now unhappily removes diminishing survivors from the more secluded fields of inquiry. It assembles an extended series of events which blend into a most interesting picture; but many of which, being individually unimpressive, might otherwise have been submerged in the course of twenty years.

The Massachusetts Historical Society possesses an invoice dated March 1633, recording import of apparatus and chemicals by John Winthrop, Jr., who set up the first laboratory in the United States. He was the eldest son of the famous pilgrim father who reached Salem, Mass., in June 1630, having been appointed the first governor of the colony in the previous October; the name of their home in England, Groton, lives in five New England States, and in the famous 56-year old American preparatory school which claims sixteen Roosevelts among its old boys. Winthrop's London supplier was Kirby, following whom after nearly two centuries was Accum, who from 1802 supplied Benjamin Silliman, chemistry professor at Yale. Then came Griffin, and Mr. Child reproduces a curious illustration of the billposting art as practised in 1837, advertising "Griffin's Bazaar", established in 1826. The cradle of the indigenous American laboratory-apparatus trade, however, was Philadelphia, because that city claims the first chair of chemistry (University of Pennsylvania) and the first American college of pharmacy.

Treatment of the title-subject, and the preliminary biographical survey of chemistry in the United States are very informative, and the book deserves a place in every science library. The printing, and the reproduction of illustrations are admirable. Having discovered a gap in the history of chemistry, Mr. Child has filled it most adroitly. M. O. F.

Aircraft Engines—Vol. I. By A. W. Judge. (Chapman & Hall, Ltd., London), 1940. Pp. 380; Figs. 226. Price 15*sh*.

This book is written by a well-known writer on internal combustion engines. The information is collected from a large number of research publications on the subject and as such the book constitutes a valuable survey of the latest information available in the field. The first part of the volume contains a very interesting account, in the light of recent knowledge of the physical and chemical processes which contribute to the efficiency and output of modern engines. Combustion chamber design, turbulence, compression ratio, rate of flame travel, detonation are all expressions which arrest the attention and on which engineers are always seeking for more enlightenment. The astonishing strides made in the output per litre in recent years makes fascinating reading. Yet the author makes no attempt at going into theoretical or design details but

explains briefly and clearly general principles with a view to clarifying their practical application. Within the scope of the book, which is expected to fill in the gap between the elementary and the more advanced books on the subject, the author has very well succeeded in conveying, with the aid of a large number of diagrams, graphs and worked-out examples, the practical aspect of the working and operation of the aircraft engine. At several places he has included useful experimental data which will not only help the reader to understand the subject but will stand him in good stead in actual practice.

The present volume which is the first part of the work does not cover the whole subject, important information concerning different types of engines, their accessories, lubricating systems, etc., which does not appear in this volume will be added in the second part.

The book has appeared at a time when its subject has assumed great importance. We are sure the book will be a valuable help and guide to many technical men, students and engineers who are particularly interested in the subject.

K. ASTON.

The Calculation and Design of Electrical Apparatus. By W. Wilson. (Chapman & Hall, Ltd., London), 1940. Pp. 230; 24 diagrams. Price 16*sh.* 6*d.*

This is the second edition of a book whose author is well known as an authority on switch and control gear. Its first edition appeared in 1934 and fulfilled a long-felt need for a book dealing with the general principles of the design of a variety of apparatus such as electromagnets, solenoids, field windings, resistors, circuit breaker parts, etc., which are not generally found in books on design. The average electrical engineer has generally no occasion to design heavy electrical machinery such as generators and transformers, but will frequently have to design a resistor or issue specifications for a circuit breaker. For the average engineer therefore the book is almost indispensable.

The second edition incorporates many changes which have brought the book up to date. Most of the elementary matter has been omitted without sacrificing the clarity of the fundamental principles, and a good deal of additional information of a recent nature has been included. The greater part of the changes has been embodied within the first five chapters. The first chapter contains formulæ for the design of liquid earthing resistors. The discussion on 'sudden heating' in the second chapter is very helpful in estimating quickly the maximum temperature rise of electrical apparatus. The third chapter on 'Forces due to electric currents' gives a very clear insight into the principles involved in the mechanical design of bus bars, switch contacts, cross bars of switches, etc. In the fifth chapter due importance has been given to modern short circuit testing. Although this subject is somewhat involved, the intimate association of the author with one of the new testing stations has enabled him to present the subject in a very simple manner. An illustrative example has been fully worked out taking a twelve element oscillogram. In view of the rather advanced nature of this subject, it would appear more logical to place the fifth chapter and the eighth chapter dealing with 'Calculation of heavy conductors' together at the end of the book.

The book abounds in numerous tables of useful data and worked examples. A set of further examples with answers has been added at the end of each chapter.

From all points of view the book will be a useful addition to one's technical library.

K. ASTON.

Thermodynamics for Chemical Engineers. By H. C. Weber. (Chapman & Hall, London; John Wiley & Sons, New York), 1939. Pp. vi + 264. Price 19*sh.* 6*d.*

The laws of thermodynamics are distinguished by the fact that they are based largely on experience. What then is more natural than to expect a wide range of utility for these laws in the practical problems of engineering? These laws have further the merit that they involve no special assumptions regarding the structure of matter or mechanism of process, and require but a few co-ordinates which can, in general, be directly measured for a description of the system or process. Thermodynamics is hence an invaluable tool for the chemical engineer for predicting the properties of his materials, and for ascertaining the driving energy required for the several unit operations.

The pure chemist is largely concerned with analysis in terms of free energy and the

engineer, particularly the mechanical engineer with entropy concepts; but the chemical engineer must be familiar with both. The book under review is divided into 20 convenient chapters, each with a summary and a set of problem exercises. These latter form a significant feature of the book and bring home very clearly the practical utility of thermodynamic considerations. The subject-matter is neatly arranged in what may be called, in the language of the chemical engineer, a didactic 'flow relationship'. The chapters on fluid flow, steam engines and turbines are concise and clear. Such studies as these have in no small degree contributed to the high efficiency of modern industrial equipments.

The reviewer has little to suggest by way of criticism excepting that Chapter XIX on 'Electrochemical effects' could be amplified to advantage. The book can be strongly recommended to all students of chemical engineering and industrial chemistry.

M. A. Govinda Rau.

Thermodynamics and Chemistry. By F. H. Macdougall. Third edition. (John Wiley & Sons, New York; Chapman & Hall, London), 1939. Pp. viii + 491. Price 30*sh.*

This is an American publication, and is intended for advanced students. Every topic in chemistry in which thermodynamics finds an application has been dealt with in this book. In a chapter on "Mathematical apparatus" the author gives a brief treatment of line integrals and emphasizes the distinction between exact and inexact linear differential expressions. Reversible and irreversible reactions are concisely but lucidly dealt with. A very clear account of entropy and a statistical interpretation of the same are also included. Besides a discussion of fugacity, activity coefficient and the theory of strong electrolytes, there is a chapter dealing with gravitational, centrifugal and electric fields and surface tension. In the chapter dealing with the third law of thermodynamics the recent methods of calculating thermodynamic functions with the aid of quantum statistical mechanics are also introduced, stressing the fact that the results obtained by these methods furnish a check on the validity and proper interpretation of the third law. Every chapter contains problems to be worked out by the students.

The book is a comprehensive summary of the applications of thermodynamics to chemical problems and contains a very large number of thermodynamical equations covering a very wide field. As a text-book for students preparing for an examination it can certainly be recommended. It is essentially a book on thermodynamics as applied to physical chemistry. It is not a book on physical chemistry treated thermodynamically; perhaps it was never intended to be.

M. R. N.

Electrocapillarity. By J. A. V. Butler. (Methuen & Co., Ltd., London), 1940. Pp. 208. Price 12*s.* 6*d.* net.

The book, as the author writes in the preface, "deals with potential differences at electrified interface, the origin and nature of the effects that arise therefrom, and with electrode equilibria and kinetics". Although limited in its scope, it touches upon subjects which are not dealt with in a single book. The value of the book is further enhanced by the fact that the author has himself made valuable contributions to the subject. The book opens with a chapter on the seat of the electromotive force in the galvanic cell, which contains a short historical account of the earlier work and views. This is followed by chapters on Thermodynamics of electrode potentials, the mechanism of a reversible electrode potential, electrode double layers, electro-kinetic phenomena, overvoltage, concentration polarisation and some electrode processes. The apparatus of Svedberg and Tiselius for determining cataphoretic mobility, which has been improved and used with great success by Tiselius in the study of the mobilities of proteins has been described in some detail in the chapter on electro-kinetic phenomena. The theories of overvoltage and the passivity of metals are also fully discussed. Each chapter is an excellent summary of the recent work and contains references to original sources. The book is strongly recommended to those who want to obtain an up-to-date account of the Chemistry and Physics of electrode and other charged surfaces in a concise form. Students of Physics and Chemistry working for their degree examinations in the pass and honours course will derive a good deal of benefit from its study. It will also be

greatly valued by the workers in the various fields covered by it. The book is well printed. M. QURESHI.

Introductory College Chemistry. By Neil R. Gordon and William E. Trout Jr. Second Edition. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London), 1940. Pp. xiii + 753. Price 21*sh*.

This is an American publication, and as is characteristic of the origin, contains matter and method of presentation which will be appreciated by all teachers of chemistry. After an introductory chapter on manipulations, metric system and use of the balance, the author starts with water for physical and chemical studies, from which oxygen and hydrogen follow naturally. Properties of gases and fundamental laws of chemistry are treated next, then the atmosphere which leads to the study of nitrogen and its compounds. After this come acids, bases and salts. Theories of ionization are presented quite early, so also laws of mass action and equilibrium. Oxygen-sulphur family claims precedence over the halogens. After the classification of elements carbon and nitrogen families are discussed.

Part II deals with metals, the order followed being analytical groupings: alkalies, alkaline earths, the ammonium sulphide group, the hydrogen sulphide group and the HCl group. The last chapter deals with elements not covered in the previous sections, *e.g.*, the rare earths, the titanium family, vanadium and the inert gases.

Experiments which the students themselves may perform are interspersed throughout. Diagrams of industrial processes and photographic reproductions of factories are other features, as also photographs of eminent chemists. Being a modern book, the structure of atoms and nuclei and the concept of valency from the electronic point of view are all discussed. Reduction, for example, is "electronisation", and oxidation is to be termed "de-electronization".

The book aims at a new approach to the study of chemistry and is based upon what is called the "project method" of instruction. Many of the "tabloid" facts of chemistry as described in ordinary text-books are replaced by experiments which the student himself performs, and by means of questions and incomplete equations to be answered and completed by him, he is led on from the familiar to the less familiar chemical reactions. The student is provoked to think for himself and otherwise trained to depend upon himself and to do his own study without much extraneous help.

This is an admirable plan. But the reviewer doubts if it can be adopted in any school or college in India, firstly due to red-tapism which will not permit of any educational experiment in an isolated institution even with an enterprising teacher, secondly due to the paucity of proper teachers—It may be a paradox but nevertheless true that the success of this project method by which the student is trained to do his own study without extraneous help depends very much on the teacher—.Then there is the time factor. The method may not permit of so much time to be devoted to only one of the many subjects which a student has to learn for his examinations.

The book can be recommended to Intermediate students. As extra reading it can be read with profit by senior students also. All teachers will find the book very helpful in teaching chemistry and they should be familiar with the new method of instruction.

M. R. N.

Elementary Crystallography. By John W. Evans and George M. Davies. Second edition. (Thomas Murby & Co., London), 1940. Pp. 149. Price 6*sh*. 6*d*.

This is the second edition of a well-written elementary text-book on Crystallography, first published in February 1924. The present edition remains practically the same as the first, with a chapter on X-rays now added on.

It consists of sixteen chapters,—the first three are devoted to a study of the nature of crystals, their symmetry and their axial characters; the fourth and the fifth deal with the systems of notation, the zonal characters of crystals, the goniometers, some simple calculations and crystal projections; in chapters 6–13 are described all the holohedral forms of the six systems, with, in two cases, the cubic and the hexagonal, also the hemihedrons; and in chapters 14–16 are taken up the study of twins, the thirty-two classes of symmetry and the investigation of crystals by X-ray.

In the Indian Universities, where crystallography is taught as a minor part of the syllabus in Geology, it may be difficult to

use this book exclusively as an elementary text-book on the subject. The introduction in the first chapter, of the Space-lattice theory, for the definition of a crystal; the free use in the second chapter, of hemihedral form-names like Trigonial Pyramids and Trapezohedra for illustrating the symmetry of Quartz; and the enumeration in the same chapter of the thirty-two classes of symmetry; and the introduction in the third chapter, of the Weiss-Miller controversy for the indexing of the lateral axes, are sufficient surprises for a student of the Intermediate to take kindly to the rest of the book. On the other hand, a student going up for the B.Sc. Pass Degree in Geology, finds early chapters like four and five dealing with Zonal relationships, the Zone-control equation, the rule of three-faces in a zone, the reflecting goniometers (the two-circle included), and the Stereographic and Gnomonic projections,—all of which are not in his syllabus. He will, however, find chapters 6–16 easily readable,—the forms of the several systems are described on symmetry considerations, their axial characters clearly enumerated and the several faces of the individual forms described in elaborate lists, embodying appropriate algebraic signs. Yet the student will find, in the treatment of the subject, some departure from other writers of elementary text-books on Crystallography, like Bayley and Williams. The Hemihedrons of the Cubic and the Hexagonal systems alone are described; and they are described on symmetry considerations, while other writers derive first, the kinds of hemihedrisms on the geometrical theory, and thereafter describe the forms. The treatment of twinning into several kinds, is again based on the presence or absence of certain elements of symmetry, whereas other writers treat them on geometrical considerations. The last two chapters on the thirty-two classes of symmetry and X-ray study of crystals give a very concise and clear account; they afford excellent reading.

The authors have throughout the book kept the symmetry treatment prominent, and have endeavoured to give to the modestly ambitious scholar, geologist, physicist or chemist, the latest and most accurate knowledge of the subject consistent with a simple treatment. When they define parameters "as *units* of measurement on the different axes", and indices as "parameters divided by intercepts", we are encountering definitions different from the familiar ones. Again, when we notice their regret that in the Monoclinic system, it is now too late to substitute the ortho-axis for the c-axis, and the terms acute and obtuse for positive and negative hemi-pyramids respectively, or, their teaching, that in the triclinic system, each mineral has its conventional crystal-setting, we are mildly reminded of a slightly advanced knowledge.

The Honours student in India might be tempted to look into chapters four, five, fifteen and sixteen for a preliminary account of some of the material he is interested in, but, as the authors themselves remark, he would prefer to take up, even for a first reading, the well-known treatises of Mr. T. V. Barker, Professor Lewis and Doctor Tutton.

For a lecturer in Crystallography to the Intermediate and the Pass Degree in India, who is not a specialist, here is a brilliant Revision text-book from Doctor Evans and his colleague, which has the same relationship to other elementary text-books on Crystallography, as that other book of Doctor Evans, *Determination of Minerals under the Microscope,* has to H. G. Smith's *Minerals under the Microscope,*—the one for the teacher and the other for the student.

P. R. J. NAIDU.

A Text-Book of Zoology. By T. J. Parker and W. A. Haswell. Sixth Edition. Vol. I. Revised by Otto Lowenstein. (Macmillan & Co., Ltd., London), 1940. Pp. xxxii + 770. Price 36*sh.*

In spite of the original assertion of the authors, we consider "Parker & Haswell" not a book for the beginner. The inductive type of treatment of the subject is probably the only plea for its being considered a beginner's book. Zoology can be taught by two accepted methods. One is the so-called type method involving the description of one representative form after another; the other is the comparative method laying greater stress on the organ and comparing it with the same or similar organ in other groups of animals. Each method has its drawbacks and its advantages, and while the first method is more convenient the second is more comprehensive.

As the original preface admits, the type treatment followed in "Parker & Haswell"

has a particular danger to the young student, who is apt in his own fashion to generalise and to treat the type as the class,—a danger which is considerable in regard to the Invertebrata and which varies in intensity in the different phyla. We grant that the type system followed here is the most suitable to the beginner but it is also dangerous only to the beginner. It is harmless to the advanced student who is chiefly concerned with the general characters of the class he intends to study and who is as interested in the variations from the type as in the type itself. The type system is more dangerous, at least less advantageous, in regard to the invertebrates. It is unfortunate that they do not lend themselves to the construction of a regular evolutionary series as the vertebrates do and any book on invertebrates is bound to include inconclusive statements regarding the relationships and affinities of certain phyla.

It is now nineteen years since the text-book was revised and there is no doubt that a prodigious amount of work has been done during this period, work which has much bearing on the phylogeny of practically every group included in the book; so that, the decision to omit all diagrammatic representations of phylogenetic relationships, is a wise one. They would at best represent a single view and would certainly introduce confusion.

The first section on the general structure and physiology of animals is of great importance and acts as an excellent introduction to the book, familiarising the student with the many technical terms that are in store for him during his study of the science and acting as a "comprehensive glossary of fundamental morphological terms which in later parts of the book, are used without further explanation". This section has been largely rewritten and has been illustrated with diagrams nearly all of which are new.

The revision of the rest of the text consists mainly in two points: first, in a re-arrangement of the different phyla, with the clear warning that any such regrouping is largely a matter of convenience rather than an implied relationship. Thus the inclusion of Bryozoa (Ectoprocta), Phoronida, Brachiopoda and Chætognatha in Section X has no more phylogenetic significance than the inclusion of Nematoda, Nematomorpha, Acanthocephala, Rotifera and Calyssozoa (Endoprocta) in Section XI. The relegation of the Mollusca to the end of Vol. I in the previous editions created, however unintended, the wrong impression that they were the most nearly related among the invertebrates to the Chordata. This, we are glad to notice, has been corrected and the Echinoderma occupy, rightly, the last section of the volume.

The second important feature of the present revised edition lies in the incorporation of newer and more recent schemes of classification of the phyla.

Finally the illustrations: nearly 150 of them are either replacements of old ones or are completely new figures, and many of these are in black and white, which forms an added advantage both to the student and to the teacher.

"Parker and Haswell" occupies an unique place among text-books of Zoology and unaffected by the numerous later English publications both in England and America, it will continue to maintain its position. The revised edition forms yet another landmark in Zoological publication and will help popularize the study of this "noble science" to the English knowing students of the world.

B. R. S.

Lectures on Malaria. By Lt.-Col. G. Covell, I.M.S. Health Bulletin No. 5. (Manager of Publications, Delhi), 1940. Pp. 33. Price Annas 5 or 6*d*.

It is surprising to see what ignorance there is to-day, even in educated and intelligent circles, as to the basic principles of Malaria transmission and its control, and that about a disease which quietly and almost imperceptibly takes a toll of over one million lives every year in India, besides incapacitating or lessening the efficiency of many millions of others. There is nothing dramatic about this disease. People do not fall down dead in street corners. There is not that terror which an epidemic of cholera or plague generally rakes up. It is a slow devitalising disease, but unlike tuberculosis, another dreaded disease, can be cured by simple and effective remedies and the percentage of fatality can be rendered comparatively low. Hence the general apathy and ignorance is deplorable.

How much of knowledge should laymen be expected to possess about this disease and how far it will help them to combat it is a moot question. Generally speaking

an individual by himself can do very little to prevent the spread of Malaria, except perhaps by protecting or curing himself. But the case is entirely different regarding laymen such as engineers, forest officers, civil servants, military, railway and plantation officers, whose duties constantly bring them into contact with the disease. A clear appreciation of Malaria problems by them may go far to mitigate its ravages, or in many cases even to prevent it. A small but very interesting example may be quoted. In 1926 Lt.-Col. Covell visited the Andamans and found a certain non-malarious village, about a mile from a salt water swamp. He studied the situation and found that between the village and the swamp was a belt of dense forest composed of high trees and pointed out that this should on no account be cut down. "A few years later an enthusiastic new Commissioner visited the village and had a broad gap cut through the belt of the forest to allow the villagers to get the benefit of the sea breeze. The result was a severe outbreak of malaria due to an invasion of the village by *Anopheles sundaicus*"! Malariology, all over the world, can point to innumerable examples such as this, of well-meant but unintelligent interference with nature by executives, resulting in disastrous consequences. One has only to study the post-history of many of the recent magnificent irrigation projects in India to appreciate the force of this point. The construction of New Delhi is another excellent example and to quote Lt.-Col. Covell, in this regard:—

> "As the result of the prevalence of mosquitoes and malaria it has now been found necessary to spend a sum of approximately Rs. 2,500,000 (£187,500) on anti-malaria works, many of which have been designed to correct conditions which should never have arisen. About half of these works have been completed but the remainder are at present indefinitely postponed owing to lack of funds. Had the necessary antimalaria work been carried out as an integral part of the construction of the new capital, it would have been done at a very much lower cost."

How different things might have been if the great builders of irrigation projects and cities had a little appreciation of the tremendous power of the insignificant mosquito. Truly, to quote another distinguished malariologist, "A colossus stumbling over a gnat".

In the pamphlet under review the author has very successfully gathered such information as may be useful to lay executives in the form of eight well-arranged lectures, dealing concisely with the history, epidemiology and control of malaria. Emphasis has been clearly laid on the point that a Malaria Control Scheme, however small or big, must be investigated and directed by a competent trained malariologist. It is a very special branch of preventive medicine, which even distinguished surgeons or physicians may not fully comprehend. Moreover, the great necessity for executives to consult malariologists, before embarking upon projects which interfere to any degree with the balance of nature has been well stressed. This is a small pamphlet but is crammed with information and is very readable. We wish that arrangements could be made to place it in the hands of every executive in India, official or non-official. T. R. R.

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1. **How to do a Malaria Survey.** By S. R. Christophers, J. A. Sinton and G. Covell: Fourth edition by Lt.-Col. G. Covell, I.M.S. Health Bulletin No. 14. (Manager of Publications, Delhi), 1939. Pp. 208. Price Rs. 1–12–0 or 2*sh*. 6*d*.
2. **Instructions for Collecting and Forwarding Mosquitoes.** Revised 3rd edition. By Dr. I. M. Puri. Health Bulletin No. 13. (Manager of Publications, Delhi), 1940. Pp. 57. Price Annas 8 or 9*d*.

These books are two of the fourteen bulletins issued by the Malaria Institute of India (formerly Malaria Survey of India) dealing with several aspects of malaria research and which are in constant use by malaria workers in India and neighbouring countries. The first of these two has now become a standard work on the technique of malaria surveys and the present edition is in bulk the same as the previous edition, a notable inclusion in the present one being a description of the modern Barber and Rice's technique of precipitin tests to determine the blood meal of mosquitoes.

The second of the two volumes is the third edition of the very useful publication dealing with the technique of handling of mosquitoes. Dr. Puri has thoroughly revised it and has presented an excellent handbook.

Both the above publications provide their own testimony of usefulness by coming out

in their fourth and third editions respectively. The instructions, mainly directed to Health and Medical Officers who take up malaria studies, are very clear and full.

T. R. R.

German-English Science Dictionary. By Louis De Vries. (McGraw-Hill Book Company, London), 1939. Pp. x + 473. Price 18*sh*.

The advancement of science in recent years has been proceeding in borderland fields where the fundamentals of two or more sciences operate. This interplay of knowledge, which had led to spectacular results, is destined to yield a richer harvest as the whole band of devoted researchers break through their watertight compartments and commence to study their problems in the light of advances made in other fields. The progressive Entomologist to-day, for example, can ill-afford to dissociate himself from the many aspects of biology; even physical sciences have been influencing the progress of entomological science.

An adequate study of German scientific literature, so essential to every research worker involves a comprehensive mastery over a wide range of vocabulary. This situation is ably met by the Dictionary which has been compiled by Professor De Vries with the active collaboration of the members of the Graduate Faculty. It is a volume which will prove extremely useful to a large circle of research workers in fields of agricultural, biological and physical sciences.

M. S.

A Student's Book on Soils and Manures. By Sir E. J. Russell. Third Edition, revised and rewritten. (Messrs. Macmillan & Co., Ltd., London), 1940. Pp. viii + 296. Price 8*sh*. 6*d*.

Sir E. John Russell, the Director of the Rothamsted Experiment Station, has brought out a third edition of *A Student's Book on Soils and Manures*. The second edition was in the year 1919. The present volume is revised and re-written incorporating the practical aspects of the progress that has been made in the intervening years between the second edition and now. Although the book is of an elementary nature written for students, and deals with British agriculture and crops, it will be useful to students outside Great Britain as an introduction to the general principles of soil management and crop growth.

B. V. N.

Annual Review of Biochemical and Allied Research in India, Vol. 10. (Society of Biological Chemists, India), 1939. Pp. 168. Price Rs. 3 or 6*sh*.

The report attempts at being a faithful record of the activities of Indian workers in a field considered biochemical. Almost all the contributors draw attention to the increasing quantity of work done in the local branches dealt with. For the new information it contains, one is nearly tempted to regard this volume as an appendix to that authoritative, annual world review of biochemistry edited by Harold Murray Luck.

The task of reviewing the work in the several branches has been performed by the respective experts attached to representative institutions in the country. To mention only a few, review on food and nutrition comes from the Nutritional Research Laboratory, Coonoor, Animal and Dairy Science from the Imperial Institute of Animal Husbandry, Bangalore, that on Pharmacology is contributed from the Haffkine Institute, Bombay, while we get an account on soils, fertilisers and manures from the Indian Institute of Science, Bangalore.

The Society of Biological Chemists has been regular in presenting these annual reports successively for these ten years now. A modest achievement, but a rich experience, yet the present volume betrays indulgent editing. Not the least among its impositions is an infectious repetition of themes.

M. S.

Statistical Year-book (1346 *Fasli* or 1937 A.D.). By Marhar Hussain. (Government Press, Hyderabad), 1939. Pp. 966. Price Rs. 5.

This is an yearly publication of the Government of H. E. H. Nizam's Government. It contains detailed statistical information about every department of the Government such as Revenue, Excise, Education, etc. The publication is a very useful one.

K. V.

WAVE-LENGTH TABLES

M. I. T. Wave-Length Tables. Compiled under the direction of G. R. Harrison. (John Wiley & Sons, Inc., N.Y.; Chapman & Hall, London), 1939. Pp. xxviii + 429. Price 90*sh.*

THE enterprise of Professor G. R. Harrison and his collaborators at the Massachusetts Institute of Technology has made possible the publication of this magnificent volume containing over a hundred thousand determinations of the wave-lengths of the lines in the atomic spectra of all the known elements except five which have not so far been studied. The Table gives the wave-lengths in international Angstrom units for all except the very feeblest lines emitted by these atoms in the first two stages of ionisation and lying between 10000 and 2000 Angstrom units. To increase the usefulness of the tables in identifying lines in spectra, 1381 band heads which frequently appear on spectrograms have also been included. About three-fourths of the entries in the tables are from determinations made in the spectroscopic laboratory of the M.I.T., this tremendous output having been made possible by the use of automatic recording comparators as described in the introductory pages of the volume. The entries of wave-lengths in every case have been carefully compared with the existing determinations. An interesting feature of the tables is the very open scale of 25 steps ranging from 1 to 9000 which has been used for indicating the intensities of the lines. Such a scale gives a truer indication of the actual relative intensities of the lines than the conventional scale usually adopted.

Every possible care appears to have been taken in the preparation of the tables which are very clearly printed on thick paper of a very pleasant cream colour. The lines are listed in order of wave-length for all the elements together, the name of the elements being given as also the stage of ionisation when this has been established by arrangement of the lines in series. The intensity and the literature reference then follows.

The volume should prove most useful to all spectroscopists. C. V. RAMAN.

THE ARCHÆAN COMPLEX OF MYSORE

The Archæan Complex of Mysore. By B. Rama Rao. (Mysore Geological Department, Bulletin No. 17 with 12 plates, 4 Geological Maps and Sections), 1940. Price Rs. 1–8–0.

MYSORE forms an important part of the Indian Peninsula, and is situated in the angle where the Western and Eastern Ghat ranges converge into the Nilgiri group of hills. The western part forms a belt of mountainous country, 20–25 miles wide, passing on to the Western Ghats, while the rest of it forms a fairly flat tableland. The geology of the area is very interesting and of great importance on account of its rich mineral resources.

A regular geological survey to map the territory and to explore its mineral resources was started in 1894 with Mr. Bruce Foote, who had already considerable experience of the geology of South India, in charge of the work. Since then our knowledge of the geology of the State has been considerably enriched by the work of several eminent geologists like Dr. J. W. Evans, Dr. W. F. Smeeth, Mr. P. Sampat Iyengar and others. The Survey has issued many valuable papers in its publications from time to time.

In the present paper of 100 pages, the author has presented, in a very lucid and masterly manner, the progress of geological ideas in Mysore during the past 46 years. He has therein made a useful and satisfactory contribution to the controversy on the origin of the Dharwar Schists in Mysore by very careful and detailed observations in the field and by analysis of representative samples in the Chemical Laboratory of the Department, and has proved that a part of the Dharwar Schists really consisted of metamorphosed sediments.

The two main geological formations of Mysore are (*i*) the Dharwar Schists, and (*ii*) a Series of acid and basic rocks intrusive into them. The Dharwar formation in Mysore consists of a series of basic and acid volcanic rocks, metamorphosed sedimentary rocks as ironstones, limestones, argillites, quartzites, conglomerates and granulitic schists, and basic and ultrabasic intrusions. Foote has described the Dharwar Schists as an intensely altered sedimentary series of rocks, which, associated with contemporary lava flows and basic intrusions, are preserved now as steeply folded, elongated synclinal bands resting unconformably on a basement complex of the granitoid gneiss. When the

examination of the Kolar Schist belt was concluded, Dr. Smeeth and his co-workers came to the important conclusions (*i*) that the conglomerate bands were of an autoclastic origin, (*ii*) that the Dharwar Schists did not rest on the granites, but the granites were really intrusive into them. Thus the Dharwar Schists became the oldest geological formation of the area.

This has also been proved to be the case in several other areas, but was contested by Mr. C. S. Middlemiss, late of the Geological Survey of India.[1] This view of the Mysore Geological Survey was accepted by Sir L. L. Fermor.[2]

The metamorphosed sedimentary rocks, quartzites, conglomerates, granulites and schists containing kyanite, sillimanite, graphite, garnet, etc., were all considered by Dr. Smeeth to be of igneous origin. Although individual geologists found some evidence for their being metamorphosed sediments, practically all the Mysore geologists had, by 1915, come to the conclusion that the Dharwar crystalline schists were really igneous in origin and that the sedimentary-looking types had been produced from igneous rocks by different processes of alteration such as crushing, alteration and replacement.

It has been found that one-sixth of the area in Mysore is covered by the Dharwar Schists and the rest by the intrusive granites and gneisses. The effects of granite intrusions on such a vast scale must have affected the Dharwar sediments very much by granitisation, hybridisation, recrystallisation, etc., that these rocks now lack distinct signs of bedding and other structures of sedimentation. This aspect of the changes in the Dharwar sediments seems to have been completely overlooked by Dr. Smeeth and his associates, who advocated a theory of igneous origin even for quartzites, conglomerates and schists containing aluminous silicates. But in most of these areas, traces of current bedding and ripple marks have since been found by Rama Rao, who, from the mineral composition of these rocks containing kyanite, staurolite, sillimanite, etc., considers them to be altered sediments.

Since the publication of the "Outlines of the Geology of Mysore" by Dr. Smeeth, several new facts have been proved by Rama Rao, *e.g.*, (*i*) the Champion gneiss has been taken out of the intrusives and their origin is doubtful, and that part of the schists has been derived from the Champion gneiss as indicated by the presence of opalescent quartz in both; (*ii*) the hornblende-schists are intrusive into the chloritic-schists and do not underlie them as an older member; (*iii*) evidence for dividing the Dharwars into three divisions by two conglomerate bands in the northern parts of the State which, due to progressive metamorphism towards the south, is not very clear there, and (*iv*) the Peninsular gneiss and the Closepet granites are the only two major acid intrusives, and (*v*) the exclusion of the charnockites from the intrusives.

Besides, a detailed study of the metamorphosed argillaceous inclusions in granite containing diopside, hypersthene, garnet cordierite, sillimanite, etc., has enabled the author and others to establish a number of new rock types, as Bandite Series, Kodamite Series, Bidalotite Series and Sakarsanhalli Series.

A revolutionary idea advocated by the author is that the charnockites do not represent the differentiated phases of a normal plutonic magma, but have been formed by interaction between the older norite and pyroxenite and the younger intrusive Closepet granite. It is this interaction between the basic and acid igneous rocks of different ages which seem to have given rise to intermediate and acid types of charnockites.

Since Sir T. H. Holland published his paper on the Charnockite Series of India no further detailed work has been published on these rocks of South India. It is rather inconceivable that such large masses of charnockite, as represented by the Palnis, the Nilgiris and Ceylon could be formed by the interaction of acid and basic rocks. Besides, in several parts of Africa and other regions similar petrographical provinces have been found.[3]

In conclusion a few points may be mentioned from the reviewer's point of view. Information on these would give additional value to the maps included in the Bulletin. (*i*) The Dharwar Schists have straight and sharp boundaries and it is not clear if they are fault boundaries; (*ii*) Dips in the schists would be helpful to understand the structure; (*iii*) The Dharwar sedimentaries could be shown separately from the igneous part of the formation and (*iv*) The Champion gneiss exposure has been omitted in the Kolar belt and perhaps in other areas also.

L. A. N. IYER.

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[1] *Proc. As. Soc. Beng.*, N. S., 1917, **13**, cxx[illegible]ii.
[2] *Jour. As. Soc. Beng.*, N. S. **15**, clxxii–clxxvii.
[3] A. W. Groves, *The Charnockite Series of Uganda*, *Q. J. G. S.*, **41**, 150.

RECENT CHANGES IN THE NAMES OF INDIAN GRASSES

IN a recent issue of *Blumea*[1] Dr. J. Th. Henrard, of the Rijksherbarium, Leiden, devotes some eighty pages to the nomenclature of certain species of the Gramineæ. As this journal is not readily available to workers in India, it is believed that a useful purpose will be served by making the result of Dr. Henrard's researches, in so far as they concern India and Burma, known to agrostologists in this country.

Setaria verticillata (Linn.) P. Beauv. is a well-known European species and is to be found listed in the Flora of British India. The European species differs, says Dr. Henrard, from the tropical by being densely ciliate on the hyaline margins of the leaf-sheath. Dr. Henrard says this is a very fugitive character and it is certainly absent in some sheets of the European material of this species in the Herbarium at Dehra Dun. It is very doubtful whether it is sound to differentiate between species on a fugitive character. Proceeding further, however, Dr. Henrard says that for this species we must accept the combination *Setaria adhærens* (Forsk.) Chiovenda. Forskal called his plant *Panicum adhærens* and published the name in the *"Flora Ægyptiaco-Arabica"* (1775), p. 20. In his description he only mentions the retrorsely barbed bristles below the spikelets and says nothing about the ciliate margins of sheaths. Moreover, the type of this species is not to be found in Forskal's herbarium. Hence it is by no means certain that the *Panicum adhærens* of Forskal is the tropical counterpart of the *Setaria verticillata* of Palisot de Beauvois. Stapf and Hubbard say with regard to this species in the *"Flora of Tropical Africa,"* 9, 827, that it is "a polymorphic species, the polymorphy probably not being so much due to the presence of a number of genetic strains as to the readiness with which the grass responds to varied ecological conditions". Agrostologists in India would be well advised to continue to call their plant *Setaria verticillata* P. Beauv. until stronger arguments validate a change.

Dr. Henrard next treats *Eragrostis major*, a well-known Indian species, which has recently been known as *Eragrostis cilianensis* (Allioni) Link. apud Vign. Lutat. based on the *Poa cilianensis* of Allioni. This name was accepted by most, if not all, agrostologists on account of a paper published by Hubbard in the *"Philippine Journal of Science,"* 1913, 8, No. 3, in which the author shows that the correct name of *Eragrostis major* Host. is *E. cilianensis* (All.) Link. and not *E. megastachya* (Koel.) Link. as Dr. Henrard would have us believe. Sprague and Hubbard, C. E., came to the same conclusion in *"Kew Bull.,"* 1933, 17–18.

Dr. Henrard next proceeds to make new combinations in the section *Avenastrum* of the genus *Avena* Linn. It has recently been shown by C. E. Hubbard (*Flor. Trop. Africa*, 1937, 10, 104) that the genus *Avenastrum* Jessen (*Deutschl. Gräser*, 1863, 214) is illegitimate as it was superfluous when published, Jessen having included in his genus the older valid genera *Trisetum* Pers. and *Arrhenatherum* Beauv. The species of the section *Avenastrum* of *Avena* found in Madras have been transferred to *Avenastrum* by Fischer in the *Flora of Madras*. These species have now to be transferred to the genus *Helictotrichon* Besser.

The species of the section *Avenastrum* found in India are named as follows in the *Flora of British India*: *Avena pratensis* Linn.; *Avena polyneura* Hook. f. and *Avena aspera* Munro. The first two species should be known in future as *Helictotrichon pratense* (Linn.) Pilger and *H. polyneurum* (Hook. f.) Henrard.

The other species of the Flora of British India is *Avena aspera* described by Munro in *Thwaites Enum, Pl. Zeyl.*, 1864, 372. Hook. f. has three varieties under *Avena aspera* Munro: (1) *Avena aspera* proper; (2) var. *Roylei* Hook. f.; (3) var. *parviflora* Hook. f.; and (4) var. *Schmidii* Hook. f.

The var. *Roylei* of Hook. f. had already been described as *Trisetum virescens* by Nees apud Steudel (*Syn. Pl. Glum.*, 1854, 226). The type *Trisetum virescens* Nees, Royle 137, is in the herbarium at Dehra Dun and it is undoubtedly a distinct species. The *Avena aspera* Munro, from the Khasi Hills, Sikkim and Ceylon is also a distinct species and it is very likely that var. *parviflora* will also have to be given specific rank. Henrard has already raised var. *Roylei* and var. *Schmidii* to specific rank, the former as *Helictotrichon virescens* (Nees) Henr.

The *Avena aspera* of the Flora of British India, in fact, disappears and the following emerge: *Helictotrichon virescens* (Nees) Henr.; *H. Schmidii* (Hook. f.) Henr.; *H. asperum* (Munro) Bor. The latter combination was made by the writer in *Ind. For. Rec. Bot. I.*, 3, 68. The distribution of these three is as follows: *H. asperum* (Munro) Bor., Assam, Burma; *H. Schmidii* (Hook. f.) Henr., Nilgiris; *H. virescens* (Nees) Henr., Western Himalaya. The consideration of the status of var. *parviflora* must wait for the present.

An addition to the grass flora of British India is *Cyrtococcum schmidii* (Hack.) Henr. based on *Panicum schmidii* Hack. from Thailand. It was collected by Young in the Southern Mahratha country and in North Canara fide Henrard. There are no specimens in the Dehra Herbarium. It is distinguished from other species of *Cyrtococcum* "verrucis crebris elevatis breviter piliferis obsita" according to Hackel.

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[1] *Blumea*, 1940, **3**, 3.

The combination *Acroceras tonkinense* (Balansa) Henrard was not made by Henrard in his paper, as he thinks, but by Hubbard, and the correct citation is *A. tonkinense* (Balansa) C. E. Hubbard apud Bor, *Ind. Forest Records* I., 3, 78. This grass appears under the name *Panicum latifolium* Linn. var. *majus* in *Flora of British India,* 7, 39.

Another Indian species, *Acroceras crassiapiculatum* (Merr.) Alston is considered by Dr. Henrard. This species is based upon *Panicum crassiapiculatum* Merril, published in 1906. It was obvious, of course, that such a common grass had been collected previcus to 1906, and Dr. Henrard says that Balansa named it in 1890 as *Panicum munroanum* Balansa. This name was, in fact, proposed for a variety of *Panicum helopus* Trin., by Munro ex Thwaites, *Enum. Pl. Zeyl.*, 1864. It seems, however, that this name was not validly published and therefore it is better to stick to the combination made by Alston for the present.

The genus *Pollinia* of the Flora of British India is now invalid and species have been distributed mainly between the genera *Microstegium* Nees and *Eulalia* O. Ktze. The well-known grass *Pollina argentea* has been transferred to *Eulalia* by Mlle. A. Camus and named *E. tristachya* (Roxb.) A. Camus, based upon *Andropogon tristachyus* Roxb., a nomen nudum in *Hortus bengalensis,* 1814, 6. *A. tristachyus* was not validly published until 1820 in *Flor. Indica.* In the meantime Humboldt, Bonpland and Kunth had published an *Andropogon tristachyus* in 1816, a circumstance which invalidates the specific epithet *tristachyus* for this grass. The next valid name for this species is that of Schultes, *A. trispicatus,* published in *Mantissa*, 1824, 2, 452. Henrard now makes the combination *Eulalia trispicata* (Schultes) Henrard. Dr. Henrard makes the following combinations for certain Indian species formerly appearing under *Pollinia. Microstegium eucnemis* (Nees) Henr.; *M. stapfi* (Hook f.) Henr.; *M. vagans* (Nees) Henr.; *M. delicatula* (Hook. f.) Henr.

The following combinations are made by Dr. Henrard in *Bothriochloa* O. Ktze., for species found under *Andropogon* Linn. in the Flora of British India. *B. ensiformis* (Hook. f.) Henr.; *B. concanensis* (Hook. f.) Henr.; *B. ischœmum* (Linn.) Henr; *B. foulkesii* (Hook. f.) Henr.; *B. pseudoischœmum* (Nees) Henr.

On page 305, *Flora of British India,* is to be found the species *Neyraudia madagascariensis* Hook. f., based on *Arundo madagascariensis* Kunth, and its variety *zollingeri* Hook. f., based on *Arundo reynaudiana* Kunth. These two are now considered to be distinct on account of the difference in habit and range as well as the presence of the empty lemma in the spikelet of the latter. The former should be known as *Neyraudia arundinacea* (Linn.) Henr., based on *Aristida arundinacea* Linn. The latter is known as *Neyraudia reynaudiana* (Kunth) Keng, based on *Arundo reynaudiana* Kunth. Dr. Henrard, however, remarks, "If we agree with Hooker's opinion that both names of Kunth belong to but one species" then the variety must be called *Neyraudia arundinacea* (Linn.) Henr. var. *zollingeri* (Buse) Henr. This new combination merely adds another name to the synonymy of *Neyraudia reynaudiana* (Kunth) Keng.

Finally, Dr. Henrard has examined the *Isachne kunthiana* Wight et Arn. of the Flora of British India. He remarks, "This species is described by Hooker in *Fl. British India,* p. 21, as *Isachne kunthiana* Wight et Arn. but that is a herbarium name and a nomen nudum placed by Thwaites in *Enum. Pl. Zeyl.* definitively (definitely ?) under *Isachne,* but Miquel published *Isachne kunthiana* Nees, in 1855 in his *Flor. Ind. Bot.*, III, 460." The specimen upon which the species is based was called *Panicum kunthianum* Wight et Arn. ap. Steudel, *Syn. Pl. Glum.*, 1854, 96, and a description was provided. The correct citation therefore for this species should be *Isachne kunthiana* (Wt. et Arn.) Nees ap. Miquel *loc. cit.* Dr. Henrard considers that the name quoted only applies to the plant found at low elevations. The Nilgiri plant which was included by Hook. f., *loc. cit.*, under *Isachne kunthiana,* he believes to be a distinct species, differing from *I. kunthiana* (Wt. et Arn.) Nees by its pubescent nodes and more open panicle. The Nilgiri plant was called *Panicum metzii* Hochst. in Steud. *Syn. Pl. Glum.*, 1854, 95, based on a sheet (no. 1276) in Hohenacker's herbarium. Dr. Henrard now proposes the name *Isachne metzii* (Hochst.) Henr., for this plant. This name, however, has already appeared as *I. metzii* Hochst. in the synonymy under *I. kunthiana* in the *Flora of British India,* where Hook. f. gives a reference to Hohenacker's plant No. 1276. If, therefore, the Nilgiri plant is specifically distinct from *Isachne kunthiana* (Wt. et Arn.) Nees, which in my opinion is extremely doubtful, the correct citation should be: *Isachne metzii* (Hochst.) Hook. f. in *F.B.I.*, 7, 24.

N. L. Bor.

THE MARKETING AND TRANSPORT OF JUTE IN INDIA

THE various aspects of the marketing and transport of jute in India formed the subject of an exhaustive enquiry by the *Indian Central Jute Committee* and the results of the enquiry have just been published as far as it relates to raw jute, the subject of the manufactured product being reserved for a separate publication to be issued shortly. The report deals in great detail with every aspect of the subject giving precise and authentic information supported by a mass of statistical data and illustrated by many diagrams and charts. Quite an important section describes the present methods of forecasting areas and production and the well-known imperfections of these methods are fully brought out; the official forecasts are found to fall short of actuals to an extent varying from 26 to 41 per cent. in the acreage alone, and in respect of out-turn by about 23 per cent. on the average. The recent arrangements for evolving a less unsatisfactory method of forecasting by adopting the random sampling technique is referred to in this connection which will be carried out as an experimental measure. The jute area in India may be put down as approximately 2,900,000 acres with an estimated production of about 10,000,000 bales giving an average yield of about 3 bales per acre. About 57 per cent. of the production is used in the Indian mills, and 40 per cent. is exported; the export value of both raw jute and manufactured products amounted to about Rs. 45 crores in 1937–38. The peculiar feature of the jute industry in India is that the cultivation is confined to Bengal, Bihar, Assam and Orissa; neither the other parts of India nor other countries in the world have been found suitable and the production outside India may be considered negligible giving India therefore a complete monopoly in the supply of this product. A good many substitutes have however been used in recent years and these have shut out jute from some of its accustomed markets notably Australia where it has now ceased to be used for wool packs. The Research Section of the Committee is said to be working on the subject of finding additional uses for jute.

The various steps in the marketing ladder are fully described in the publication with recommendations for minimising losses to the actual grower. It is also a singular fact that this huge production is derived from very small farmers, about 37 per cent. of growers in East Bengal and 50 per cent. in other jute areas produce less than ten maunds and those who produce over 30 maunds number only about 12 per cent. Attention is drawn to the difficulties of transport on account of the inundation to which the country is subject regularly during part of the year, and which is one of the chief reasons why growers are forced to sell the fibre quickly, indebtedness and poverty being as elsewhere other causes operating against holding up the crop in expectation of higher prices; but from the trend of prices given in the report it is seen that prices rule high during the months after harvest and then fall continuously from which one gathers there is no advantage in helping growers to hold up produce. An example of the difficulties of transport is furnished by East Bengal where 85 per cent. is by country boats, quite 10 per cent. by headloads and some 5 per cent. by carts and ponies.

The marketing intermediaries and their methods and even malpractices are very similar to what prevails with other products and form familiar reading. A bewildering multiplicity of weights and measures, frauds in weighment, various unjustifiable market charges, deductions for alleged inferiority in quality, moisture content and so on, ignorance of the price fluctuations on the part of growers, watering of the jute, adulteration with inferior grades, price fixation not by open bidding but secretly under cover,—these features characterise the jute trade quite as much as they do all agricultural marketing in this country. The remedies recommended are also more or less familiar. The organisation of regulated markets, standardised weights and measures, legislation on the lines of Cotton Transport Act, publication of daily prices in the village by suitable means including radio, improvement of rural road and other means of transport are among the suggestions made. Reference is made to co-operative sale societies but Bengal seems to have had disastrous experience of such societies; between 1925 and 1929 as many as 16 societies were formed including a wholesale society but by 1930 all of them had to be closed involving a loss of Rs. 20 lakhs! It is doubtful if in the face of this experience further ventures in this field will be viewed with favour.

The price structure compiled reveals that taking Calcutta delivered price as Rs. 100, the producer received Rs. 81, transport and handling absorbed Rs. 10, market allowances Rs. 3 and standing charges of balers Rs. 6. Although some of these charges are capable of reduction especially the market allowances and the balers' charges for being passed on to the grower, still it is evident that the grower does not get a bad deal after all, especially when it is remembered that he sells quite 75 per cent. of his produce either at his door or in nearby weekly fairs and that between 80 and 90 per cent. of the crop is sold and converted into money within three or four months after it is ready for sale.

The large terminal purchasers at Calcutta both for the mills and for export are exceedingly well organised as may be assumed in an industry of this magnitude. The *Indian Jute Mills Association* is the most important organisation and it exercises great influence in the general conduct of the jute trade. The futures market is in the hands of three Associations, their working leaves much to be desired and recommendations are made in this behalf. Among matters for research are mentioned the subject of the moisture content of raw jute, the evolving of a method of classification of qualities and grades on scientific basis and a determination of the spinning qualities of the different classes of jute. An account is given

of the frequent changes in standards fixed for the trade qualities with the attendant confusion and room for arbitrary assessment of values. Improvement in methods of preparation and storage are also among the questions being studied.

Scientific work has resulted in the evolution of high yielding strains in both the species grown, *viz.*, the *capsularis* and the *olitorius*. In 1937–38 it is said that 53 per cent. of the jute area in Bengal was cultivated with these improved strains, a very notable testimony to their superiority over the ordinary strains. Reference is made to a scheme of seed distribution which resulted, strangely enough, in the extraordinarily high price of from 12 annas to Re. 1 per seer of Government seed as against one and a half annas to two annas for bazaar seed. As a result, in that year only one per cent. of the jute area was sown with seed from Government supply. It should certainly be possible to remedy this state of affairs. Special efforts are, however, being made with suitable funds to extend the supply of improved seed. The report is a mine of valuable information, statistical and descriptive, on the various factors relating to the marketing of raw jute.

A. K. Y.

CENTENARIES

Mallet-Favre, Jaques Andre (1740–1790)

JAQUES ANDRE MALLET-FAVRE, a Swiss astronomer, was born at Geneva in September 1740. He was a favourite pupil of Daniel Bernoulli. About 1770 he became professor of astronomy at Geneva and built its observatory. He wrote seven papers, the field covered being probability, astronomy and mechanics. The first paper entitled *Recharches sur les avantages de trois joueurs, etc.*, appeared in 1762 in the *Act. Helvet.* He was a fellow of the Royal Society of London and its *Transactions* of 1767 contained his *Memoir concerning the most advantageous construction of water-wheels, etc.*, in which he investigated the most advantageous number and size of float-boards.

Mallet died at Geneva 30 January 1790.

McClintock, Emory (1840-1916)

EMORY McCLINTOCK, an American actuary, was born at Carlisle, Pa, 19 September 1840. His father was a clergyman who acted as professor of mathematics in Dickinson College for a time. While Emory was an undergraduate at Columbia, his remarkable ability excited the admiration of his professors. When one of his teachers fell ill in April 1859, he was graduated as an emergency measure and appointed tutor. But he migrated to Paris in 1860 along with his father. After studying chemistry at Gottingen, he returned to America in 1862. He was appointed as an engineer of the United States Army, but, on his way to Washington, suffered a sunstroke which prevented him from entering the army. After seeing various appointments, he finally settled down in 1889 as actuary of the Mutual Insurance Company of New York.

Contribution to Actuarial Science

McClintock's grasp of the insurance problem and his recommendations in the general reorganisation of the American life-insurance companies in 1905–1906 made him for many years the recognised leader in actuarial circles. He was one of the founders of the Actuarial Society of America (1889) and later its president (1895). He was also a member of the permanent committee of the International Congress of Actuaries.

Contributions to Mathematics

McClintock was also one of the founders of the New York Mathematical Society (1891) and one of the leaders in transforming it into the American Mathematical Society in 1894. It was chiefly through his encouragement and support that its *Bulletin* (1891) and *Transactions* (1900) were started. It was again his influence and financial assistance that led the Society to publish (1896) the *Proceedings* of the International Mathematical Congress held at Chicago in 1893. He never failed to stimulate and inspire every one of scientific aptitude with whom he came in contact.

His Papers

In addition to several contributions of actuarial nature, McClintock published no fewer than 23 papers which belonged to the domain of pure mathematics. His first paper entitled *An essay on the calculus of enlargement* (1879) was an attempt to present the calculus of finite differences and the differential calculus from a unified point of view. This paper is looked upon as a precursor of recent attempts to consider difference equations as differential equations of infinite order. His *Analysis of quintic equations* (1885) and other papers on the same subject indicate his truly remarkable power of manipulation and clearness of vision.

McClintock died 10th July 1916.

S. R. RANGANATHAN.

University Library,
Madras.

SCIENCE NOTES AND NEWS

Class-field Theory.—Following the brilliant work of his thesis C. Chevally has ("La theorie du corps de classes," *Annals of Mathematics*, 41, pp. 394–418) developed the class-field theory of an algebraic field K to infinite abelian extensions also. He considers the field of extension of K which includes all abelian extensions. The corresponding Galois group is infinite but as G_k is in general a topological group whose structure is that of the Cantor discontinuum, its group of characters is finite. We owe to the great Russian mathematician Pontrajin the result that an abelian group with this structure is determined completely by its group of characters and *vice versa*. Following the ideas of Hasse and Van der Waerden, Chevally gives a nice theory of the units of an algebraical field.

He considers an algebraic field K (of finite degree). If p is a prime divisor of K (same as prime-ideal if it is a finite divisor) let K_p be the corresponding p-adic field. Let $K^*(p)$ be the multiplicative group of K_p (excluding o). Then if we denote by G the direct product of all possible such groups, then each element a of G is determined by its co-ordinates L_p $CK^*(p)$. Then the subgroup of G composed of those elements L which are such that except for a finite number of p's L_p is a p-adic unity is denoted by J_k called the fundamental group of the field K. (This corresponds to the group of unbranched ideals in the classical theory.) The elements of J_k are called *idele* instead of the French term 'ideaux'. These idele as opposed to the usual ideals enable him to extend the classical theorems of class-field theory to infinite abelian extensions. Instead of the multiplicative group of principal ideals he considers an analogously defined P_k. Another important notion introduced by him is the notion of differential of an algebraical field which is the following. It is easily proved that every character of J_k is of finite order as J_k is perfect and discontinuous in its topological structure. Then a differential of K is a character of J_k which is $= 1$ for every element of P_k In a sense this theory corresponds to the theory of differentials in algebraic functions. He then shows that group of characters of G_k is isomorphic with the group of differentials of k from which when we translate into the theory of the usual ideals we come to the general reciprocity theorem of Artin. The central theorem of his paper is the following.

Let K be a finite algebraic field. Then there exists an isomorphism $\chi \rightarrow \phi = \phi_k(\chi)$ of the group of characters χ of the Galois-group G_k of the complete abelian extension of K over K and the group of differentials of K. This isomorphism possesses the following properties:

1. If Ω/K is a finite extension of K then

$$\phi_\Omega[N_{\Omega/k}(x)] = N_{k/\Omega}[\phi_k(x)]$$

2. If K^τ be any congujate field

$$\phi_{k^\tau}(x^\tau) = \{\phi_k(x)^\tau\}$$

3. The prime-divisors of the ramification of χ and $\phi_k(\chi)$ are identical.

He then proves theorems analogous to those of the Hilbert-Hasse theory of finite extensions after establishing inequalities analogous to those by Takagi. K. V. I.

A Quantitative Determination of the Neutron Moment in Absolute Nuclear Magnetons.—The first determination of the magnetic moments of the proton and the deuteron by the molecular beam method was carried out by Frisch and Stern. The values obtained were $\mu_p = 2{\cdot}5$ and $\mu_d = 0{\cdot}8$ nuclear magnetons. The modification of the molecular beam method due to Rabi and his collaborators has made it possible to determine these moments more accurately as $\mu_p = 2{\cdot}785 \pm 0{\cdot}02$ and $\mu_d = 0{\cdot}855 \pm 0{\cdot}006$. The magnetic moment of the neutron was hence expected to be of the order -2 nuclear magnetons since $\mu_p + \mu_n = \mu_d$. Attempts have been previously made to determine the neutron moment by direct experiments. One method has been to study the intensity of a scattered neutron beam when the scatterer was magnetized. This method however is not of any accuracy. Another method adopted by Frisch, V. Halban and Koch was to find the change in polarisation of a neutron beam by a magnetic field. Even this method did not give accurate results. Alvarez and Bloch (*Physical Review*, 1940, 57, 111) have used a resonance method which has given accurate results. The neutrons are made to precess about a field H_0, say in the Z direction and then subjected to an oscillating field in the X direction $H_x = H_1 \cos(\omega t + \delta)$. Neutrons with $m = ½$ have a probability P of changing over to $m = -½$ given by

$$P = \frac{\sin^2\left[\frac{\mu H_1 T}{2\hbar}\left(1 + \left\{\frac{2\triangle H}{H_1}\right\}^2\right)^{\frac{1}{2}}\right]}{\left[1 + \left(\frac{2\triangle H}{H_1}\right)^2\right]}$$

where T is the time that the neutrons spend in the field and $\triangle H = H_0 - H_0^*$ with $H_0^* = \hbar\omega/2\mu$. H_0^* is the value of the field when the Larmor frequency is equal to ω. T is different for different neutrons and so the average value of $\sin^2 = ½$ can be taken. Then

$$P = \tfrac{1}{2}\left[I + \left(\frac{2\triangle H}{H_1}\right)^2\right]^{-1}$$

when P is max. $\triangle H = 0$ and $H_0 = H_0^*$. If a fraction f_i^+ and f_i^- of neutrons with $m = \pm ½$ pass through a plate F_i and if a polarising plate F_1 and an analysing plate F_2 are used (magnetised in the Z direction), the total fraction transmitted $f = f_1^+ f_2^+ + f_1^- f_2^-$. If a probability P exists for m to change from $+½$ to $-½$, $f' = (1 - P)(f_1^+ f_2^+ + f_1^- f_2^-) + P(f_1^+ f_2^- + f_1^- f_2^+)$. Hence there is a change in

intensity of the beam such that

$$\Delta I/I = (f' - f)/f = -\alpha P \text{ where}$$

$$\alpha = (f_1^+ - f_2^-)(f_2^+ - f_2^-)/[f_1^+ f_2^+ + f_1^- f_2^-].$$

The maximum value of $\Delta I/I$ is found from experiments with counters filled with BF_3. It is $= -\alpha/2$. The field H_n^* at which $\Delta I/I$ is maximum is found and then $\mu = \hbar\omega/2H_n^*$. To find H_n and ω the authors use an ingenious method. They find the frequency ω_p of a field H_p which resonantly accelerates protons in a cyclotron. This is given by $\omega_p = \frac{eH_p}{Mc}$, where M is the mass of the proton.

But $\omega_n = \left(\frac{2H_n \mu_n}{\hbar} \frac{e\hbar}{2Mc}\right) = \frac{eH_n}{Mc} \mu_n$ where μ_n is in nuclear magnetons.

$$\therefore \quad \mu_n = \frac{\omega_n}{\omega_p} \frac{H_p}{H_n} = -1 \cdot 135 \pm 0 \cdot 002 \text{ nuclear}$$

magnetons.

This value shows that $\mu_p + \mu_n = \mu_d$ within experimental error. This is rather hard to understand since for it to be true the state of the deuteron should be $^3S_1$ which it is not since it has a quadrupole moment, or μ_p and μ_n must be additive without any change due to the interaction of proton and neutron.

T. S. S.

Fuel Crops in South Indian Dry Forests.—The raising of plantations in the drier regions of South India which fail to receive the full impact of either monsoon is beset with a great many difficulties—sylvicultural, economic and protective. Meanwhile, the demand for fuel from these tracts is on the increase and getting more urgent. And thus arises the great practical importance of devising suitable technique for the artificial regeneration of the dry fuel forests. It appears now that, as a result of prolonged and systematic research, this problem has at long last been solved in broad outline, although further experience might indicate minor improvements. The methods employed, the costs involved and the results that might be expected are succinctly summarised by Mr. A. L. Griffith, Provincial Sylviculturist, Madras, in "A Note on the Artificial Regeneration of the Dry Fuel Forests of the Madras Province" (Manager of Publications, Delhi, 1940, price Re. 1 and annas 14). The "rab-Kumri" method (as this system has been named) has, in the words of Mr. M. V. Laurie, the Central Sylviculturist, Dehra Dun, "the additional advantage of providing land for cultivation and employment for the poorer people living on the margins of the forest". Mr. Griffith's account of the technical details of the method while not sacrificing scientific accuracy is at the same time very readable, the more so because of the excellent photographs accompanying the text. In fact a keen forester with the aid of this Note should be able to plan an experimental plantation. But foresters as a class are conservative and it might well be that the task of converting them to these newer methods is more difficult than the success of the method would lead one to expect. Such education by demonstration is the next logical step. EMMENNAR.

Infestation of Grain by Insects.—The Department of Scientific and Industrial Research has just published a report ("Report on a Survey of the Infestation of Grain by Insects", published H. M. Stationery Office, price 1*s.* 3*d.*) on the extent to which stored grain is infested by insects. The survey which it describes was made at the request of the grain trade and with its assistance and financial support.

The report states that infestation by insects is to be found in docks, farms, merchants' premises—in fact, throughout the whole chain of transport and storage. These insects are not natives of the British Isles, but were and still are brought in with grain and other produce; and, although they cannot live and breed on British crops or corn stacks in the field, they do thrive in barns, granaries, warehouses, and mills.

After brief descriptions, illustrated with photographs and drawings, of the most important species of insects which attack grain in store and of the part played by mites, the report shows how insects, once landed at the ports, are distributed right through the country. The links in this chain of distribution, *i.e.*, dock premises, transport vehicles and containers, mills and agricultural merchants' premises, farms, breweries, and distilleries are all dealt with in turn. A diagram illustrating the movements of grain shows how home-grown grain, which is free of insects when harvested, can become infested on the farm.

While it is hard even to guess at the vast amount of damage done by these enemies which prey on the nation's food supply, the first line of defence against them is the commonsense rule of health—scrupulous cleanliness and separation of the infested from the healthy.

Obviously if the loss and inconvenience caused to industry was becoming intolerable in normal conditions it cannot be tolerated when every effort must be made to avoid waste of food supply and the publication of this report is a timely warning of the risk to be faced.

The report includes a declaration made by representatives of many sections of industry that since all concerned must share the responsibility for infestation, good commercial practice requires every section of industry to treat infestation as a "notifiable disease" and so make possible the segregation of infested goods.

Flax Cultivation in India.—A scheme for growing *flax* in India, estimated to cost Rs. 4,50,000 has been approved by the Government of India. About 1,200 acres will be sown shortly in Bihar and Bengal. The seed, purchased in Holland, has arrived in Calcutta and if germination tests are satisfactory, the necessary machinery will be ordered. The scheme includes guarantees to cultivators designed to discount the risks attendant on the growing of a new and unfamiliar crop.

The flax plant belongs to the same species as linseed, which is grown extensively in India. Some difficulty was experienced in obtaining

seed, for which there is a keen demand in the United Kingdom and Ulster.

The question of flax spinning is already under consideration by the *Indian Central Jute Committee.*

Seventy per cent. of the world's supply of flax comes from Russia. Small quantities are also produced in the United Kingdom and Ulster. Recently, however, the war demand for flax has increased enormously, particularly for the Admiralty, Defence, A.R.P. and other services.

Experiments on the cultivation of flax in India have been in progress for some years in Bihar, Bengal and the Punjab. These experiments have already shown that there is immense scope for such a venture.

The Bengal Government has been making experiments with seed brought from Ireland and grown at the Government farms at Dacca, Rangpur, Dinajpur and Berhampore.

Control of Lantana Weed by Insects.—A lantana bug which is capable of destroying lantana flowers and shoots in a spectacular manner has recently been established in Australia from Fiji and Hawaii. This bug could do useful work in India, but its introduction should be carefully supervised.

A survey carried out by the *Forest Research Institute*, Dehra Dun, showed that there are no indigenous insects that can be used to exterminate lantana in India, although some 400 species visit this weed.

The possibilities of control of lantana have been discussed in a recent publication of the Forest Research Institute. It is suggested that a concerted policy on the lantana problem by the Central and Provincial Governments should be adopted in the near future as it is not improbable that unauthorised importation might take place and this may create a problem more difficult to solve than extermination of lantana itself.

The *Annual Report* of the **Hydrodynamic Research Station, Poona**, for the year 1937–38, recently issued [*Research Publication* No. 1. (Manager of Publications, New Delhi), 1939. Pp. 85. 150 Figs. Price Rs. 7–8–0] is a very valuable document. The Station is located downstream of the Dam of Fife at Khadakavasla and was opened some 12 years ago. The Station, at present, has a length of channels and models exceeding 2,400 feet and it occupies an area of about 6 acres. Various problems relating to hydrodynamics and irrigation are referred to it for study. The results of a few experiments conducted at the Station are given below:—

To study the causes of the wide variations in the courses of rivers in Bihar, a small model of the Ganges and three of its tributaries was made. Experiments indicated that these changes were natural but the severity of those movements was heightened by the flood embankments. To determine the likely changes in the river during the next few years, experiments on a large-scale model of the Ganges above the Hardinge Bridge are in progress.

In the case of a ferry crossing, across the river Mula, rendered unsuitable by the construction of a causeway below, experiments on models with erodable banks indicated that a Burma Spur (shaped like a hockey stick pointing upstream) projecting from the convex bank deflected the main flow of the river round the bank and created satisfactory flow conditions at the crossing. The 1937 floods greatly increased the sinuosity of this part of the river and the possible utility of the extension of the existing Burma Spur was rendered doubtful. Alternative methods for diverting the main river are being tried on the model.

The shifting of river Jumna at New Delhi, away from the Delhi Gate Pumping Station and the damage done to Kaira Town on the left bank of the Watrak river during the 1937 floods are subjects of investigation on models constructed to reproduce the flow of the rivers in the vicinity and the effect on the courses of these rivers caused by the removal or extension of the existing spurs or the addition of spurs of various designs, is studied.

Silt exclusion from the Faizwah canal was indicated as possible by experiments on a modified model of Faizwah Head Regulator, ex-Khairpur West Feeder, with the channel at full supply level made to converge at 1 in 5 just upstream of the Faizwah and diverge at 1 in 10 at surface on the downstream. The modified model lowered the silt ratio to about one as against a ratio of 10 to 1 of Faizwah to Khairpur as determined by experiments on a model of the existing Faizwah Head Regulator. To study steps to be taken to reduce silting in the North Western perennial canal, experiments on a model 170 feet long of the river Indus and the Lloyd Barrage are in progress.

Afflux experiments on models of the Mula causeway at Rahuri showed that the curved bellmouth was best for low discharges, the semicircular was yielding slightly better results for high discharges. Experiments were also conducted to investigate the distribution of flow in a divergence and to test the various practical devices such as baffle type and grid type stabilisers to make the flow "fan out" satisfactorily. Work on the Silt Abrader indicated that abrasion in the boulder and pebble reaches of rivers occur mainly while the stones are at rest due to finer material passing over the stones. This is also found to be true to a large extent in the case of coarse silt. With finer silt, abrasion takes place as the sand waves move along the bed forming ripples. Experiments on a model of Burma type spur showed that it will remain stable if the nose, to which the severest attack of the diverted main flow is confined, is constructed strong enough to withstand attack.

Determination of the basic laws of downward flow above a water-table has been the subject of a series of experiments conducted to measure the seepage through columns of silt.

In connection with the protection of the Hardinge Bridge, experiments conducted to study the launching of an apron, the cause of failure of apron protection, the best design of aprons laid on sand and on alternating layers of

sand and clay and a good method of reinforcing aprons already launched, have led to valuable conclusions. The falling apron appears to be quite stable, if supplied with sufficient stones and self-adjusting to resist all possible attack.

The paper on "The use of models for elucidating flow problems" by C. C. Inglis shows how model experiments are valuable in the solution of practical engineering problems, how results of high qualitative and even of quantitative accuracy may be got from large models and how while some types of models yield results suitable for immediate application there are other types, specially those pertaining to flow in alluvial rivers, which present great practical difficulties. The paper on "The exclusion of silt from the heads of canals and distributaries" by C. C. Inglis and D. V. Joglekar stresses the importance of an approach channel taking off where the beneficial effect of curvature of flow is a maximum.

The investigations undertaken by the Research Station are undoubtedly of considerable value. The usefulness of the Hydrodynamic Research Station has been greatly appreciated and its advice on various problems is being increasingly sought. C. GOPALAKRISHNAN.

The Indian Association for the Cultivation of Science.—A brief account of the activities of the Association for the year 1939 is recorded in the *Annual Report* of the Committee of Management, just issued. The scientific work carried out in the laboratories of the Association under the inspiring guidance of Prof. K. S. Krishnan, F.R.S., is given in Appendix II of the report. The work includes the following topics: (1) The Magnetic Properties of a Free-Electron Gas, (2) The Landau Diamagnetism and its Experimental Verification, (3) The Metallic Properties of Graphite, (4) The Mobile-Electrons in Aromatic Molecules, (5) The diamagnetism of Aromatic Molecules, (6) Optical Studies on Aromatic Molecules, (7) Magnetic Studies on Bismuth in the Neighbourhood of its Melting Point, (8) Some Paramagnetic Studies, and (9) Structural Studies on Organic Crystals. Dr. S. C. Deb, D.Sc., who was re-appointed Research Fellow during the year, carried out a systematic study of the band spectra of the transition group of elements. In all 16 research papers were published during the year from the laboratory.

The Association continued its usual educational activities. A course of lectures in physics and chemistry was given for the benefit of the students of the Calcutta Medical School. Nine Seminar Lectures were delivered during the year. Meteorological reports were issued regularly to several local newspapers.

The Indian Journal of Physics, the official organ of the Association, continued to appear regularly during the year. Three special publications—(1) Garnets and their role in nature by Sir L. L. Fermor, (2) The Royal Botanic Gardens, Kew; Studies in the Germination of Seeds by Sir Arthur Hill and (3) Interatomic Forces by Prof. J. E. Lennard-Jones—were also issued during the year.

We note that the Government of India hav[e] been moved to enhance the annual grant from Rs. 18,000 to Rs. 27,500 so as to enable th[e] Association to provide for additional annua[l] expenditure. The Government of India hav[e] also been requested to sanction a non-recurrin[g] grant of Rs. 32,000 for providing hostel, library workshop and laboratory facilities. We trus[t] that the government will generously respond t[o] these requests and thus assist this premie[r] Indian Scientific Organization to finance its enhanced activities.

The Indian Research Fund Association.—The enquiries financed by the Indian Researc[h] Fund Association cover a wide field and includ[e] most of the major diseases affecting the healt[h] of the people of this country. According t[o] the *Annual Report* for the year 1939, a sum o[f] nearly Rs. 4,76,000 was distributed during th[e] year in the form of grants.

At the Haffkine Institute, research work o[n] an anti-plague vaccine with maximum pro-tective power was in progress. A serum for th[e] treatment of plague patients had been prepare[d] by this Institute and had undergone limite[d] trials with encouraging results during certai[n] epidemic outbreaks. A considerable amount o[f] work was carried out during the year o[n] leprosy. It was shown that the adoption o[f] a wheat diet by patients, affords considerabl[e] relief in respect of chronic bone and nerve pai[n] associated with leprosy. The administration o[f] skimmed milk to children with the more sever[e] forms of leprosy, appears to help towards cure.

A nutrition museum was established in th[e] *Nutrition Research Laboratories* at Coonoo[r] which is maintained by the Indian Researc[h] Fund Association. Ever since it came in[to] existence in 1911, the Association has devote[d] increasing attention to the study of nutrition problems and to the practical application of th[e] results of such study to the improvement [of] the diet of the people. During the year 19[39] some fifty surveys on the state of nutritio[n] and the dietary habits of the people were con-ducted in various parts of the country. Analys[es] of the common food-stuffs of India for asce[r]taining their nutritive values were also carrie[d] out.

Indian Central Jute Committee.—At [a] meeting held on 4th September, the Committ[ee] decided on the policy of collaboration wi[th] the Universities of Calcutta and Dac[ca] and to co-opt some professors of t[he] universities on its technological and agricu[l]tural research sub-committees. According [to] a press note issued by the Committee, t[he] immediate objects of the collaboration [are] primarily twofold: (1) The Committee thoug[ht] that the university scientists, many of wh[om] were perhaps working on similar lines, ma[y] offer valuable advice on the work that [was] being done in the Committee's Research St[a]tions. Even if their immediate work [was] different from the investigations that were be[ing] undertaken by the different technical secti[ons] of the Committee, they felt that their familiar[ity] with the basic scientific methods and proces[ses]

might be of considerable help and value to the Committee's research workers. (2) The Committee were inclined to think that the universities, on their part, could also further their aims and objects by undertaking fundamental research on a number of subjects for which there was not, and indeed could not be, any room in the programme of work laid down for the different sections of the Committee. Such fundamental investigations might lead to results of far-reaching consequence which might be of abiding benefit to the jute industry of this country.

This policy will not involve the Committee in any financial commitments in advance. It will be open to the Committee to subsidise research at the universities, but only if, and to the extent, that its funds permit.

Jute Substitutes.—The intrusion of substitutes into the markets hitherto exclusively served by jute manufacturers is the industry's most pressing and difficult problem. Competition has recently been coming forward from cotton, sisal and paper interests, though the manufacture of paper bags has been largely curtailed as a result of the war. The extension of cotton substitutes has recently been noticed in France, Italy and more persistently so in the Argentine.

Among the substitutes which have received some attention, mention may be made of 'Jutital' and 'Ginster'. Tests on the former have not progressed beyond the experimental stage. 'Jutital' is the fibre extracted from the *typha* plant. Better progress has been made with 'Ginster' (furze) the acreage under which has recently been considerably increased by Italian authorities. In Spain, experiments have been successfully carried out on the use of *esparto* grass for packing cloth. A cloth consisting of 20 per cent. of hemp and 80 per cent. *esparto* is reported to possess desirable properties for use as packing cloth and in the manufacture of shoes.

Central Committee for Food Standards.—The report of the special committee appointed by the Central Advisory Board of Health, to study the questions relating to the prevention of food adulteration in India, came up for consideration at the last meeting of the Board, held at Poona (July 22-24), under the chairmanship of Sir Girija Shankar Bajpai. The Committee examined the problem of food adulteration from three aspects: (1) the technical, including food standards and technique of food analysis, (2) legislative, and (3) administrative. The Committee had so far examined only the technical aspect of the problem. Emphasis was laid on the fact that the improvement of methods of food analysis and the prevention of food adulteration in India, will have to be a continuous process and that the establishment of co-ordination between the provinces is a matter of utmost urgency. With this object in view the Board recommended the appointment of a standing committee to be called "The Central Committee for Food Standards" which would be in a position to advise the Central, Provincial and State Governments on all aspects of food adulteration. It is important that the standards suggested by the Committee should be acceptable to all the governments concerned, thereby facilitating inter-provincial trade and a uniform enforcement of food adulteration laws. One of the important functions of the Central Committee would be to issue from time to time "instructions" to public analysts incorporating the latest available information regarding methods of analysis.

The Centenary of the Polarimeter.—On the evening of the 7th September 1840, Jean Baptiste Biot described to the *Academie des* the rotatory power of liquids". D. Sidersky, the rotatory power of liquids." D. Sidersky, writing in the January-February number of the *Bulletin de l'Association des Chimistes* (p. 3), reminds us of this in an interesting survey of the birth and development of polarimetry. The science seems to have been made peculiarly their own by the French, at least in its early stages of growth, for the important modification of Biot's instrument by the introduction of two fields of view in juxtaposition, was made five years later by a compatriot, Soleil. Apart from this improvement, and the substitution of a Nicol prism as polariser by Ventzke in 1842, the polarimeter in its present-day form is substantially the same as that designed one hundred years ago by Biot.

It was in the course of his study of the optical activities of sugar solutions that Biot was led to produce his instrument, and less than ten years had passed before Clerget published his classical studies of the analysis of sugars, made with the aid of Soleil's "half-shade" modification. Since then the field of application of the polarimeter has greatly increased, but it still remains pre-eminently the tool of the sugar chemist and his colleague in the brewery. For those who are interested to know more of Biot's work we can recommend the reading of M. Sidersky's article, and of Biot's own account of it as given to the *Academie*, which is reproduced in the *Bulletin*.

(*J. Inst. Brewing*, 1940, 46, 196.)

Physiographic Divisions of India.—The problem of dividing India suitably and with a view to serve all purposes, economic and others, is getting increasingly urgent. It is the business of Indian geographers to guide the country in this manner. Various proposals have been made for dividing the country suitably, but the method of physiographic division is the most suitable for all.

For instance, there is the redistribution of the political boundaries of India demanded by the people according to languages. Commenting on certain dynamic problems of India, Dr. A. Geddes said last year, "In view of the burning interest in peninsular India in the question of 'linguistic provinces', it may be well to mention certain related problems. The relation of language, of religion, and of other criteria of culture, not only to each other but to economic distribution can undoubtedly be clarified by conscientious use of *geographic method*. In Southern India, at this time, when few regard the internal political boundaries as either economic, just or final, I was struck by the rarity of any discussion of possible economic

provinces. The concept of the region and even the word is rarely met with. I have little doubt that, as the mapping of important distributions proceeds without slavish adhesion to existing political boundaries, geography can do much to guide the reformation of her internal political frontiers". No doubt the Madras Geographical Association has made a good beginning with local regional problems. Had we but succeeded in making a satisfactory division of India to serve such purposes, we, Indian geographers, would have got greater credit than what foreigners have been able to give us. In our efforts to do so, we are really helped by nature. When we know, for instance, how well the Province of Western Peneplains, proposed by me, includes all Gujarati-speaking people and the Deccan Trap Province all the Marathi-speaking people, the hope of making a division of our country physiographically to meet all our requirements could be fulfilled at last.

Even for the purposes of a Federated India, the scheme proposed by Sir Sikander Hyat Khan, of dividing India into certain zones, can be helped and improved upon by geographers, and the difficulty of bringing into the Federation, all the British Indian Provinces and the Native States, not as two distinct components but as integrated parts of a completed whole, can be solved on the regional basis. "It will encourage collaboration between contiguous units, *i.e.*, both British Indian provinces and Indian States whose geographical proximity, common language and affinity of economic and other interests form natural ties to bind them together." So also in the matter of communications, sharing of economic resources, racial and cultural relationships, etc. Such physiographic divisions would be ideal and the services, rendered by Indian geographers to India in this connection, will be valuable. If Sir Sikander Hyat Khan's scheme of the seven zones is substituted by that of the 15 physiographic provinces proposed by me, it would serve the purpose well and an excellent uniformity could be attained from the points of view of representation and administration. It would, indeed, conduce to the solidarity of the whole country and the stability of the Central Government for all times. Let me hope that this dynamic problem will receive a satisfactory solution during the year 1940.

M. B. PITHAWALLA.

We congratulate **Dr. Maneck Bejanji Pithawalla**, D.SC., B.A., L.C.P., M.R.A.S., M.R.S.T., F.G.S., on his obtaining the D.Sc. degree of the Bombay University awarded to him for his researches in the science of geography. This is the first instance of such a distinction having been gained by an Indian scientist. Dr. Pithawalla's contributions have earned the warmest approbation of competent European authorities. His papers on "Physiographic divisions of India" and "A geographical analysis of the Lower Indus Basin" form notable contributions and provide the necessary stimulus to students and research workers in the much neglected field of geography. His example, no doubt, would be an inspiration to others. As Principal of the well-known institution, Bai Virbaiji Soparivala Parsi High School, he has exercised the great moral influence over the pupils whose warmest gratitude and appreciation he has won. Dr. Pithawalla has literary gifts which he has used in publishing works in prose and in verse on religious subjects which are acknowledged as works of great value.

Mr. M. Swaminathan, M.Sc., Chemist, Nutrition Research Laboratory, Coonoor, has been awarded the D.Sc. degree in Chemistry of the Madras University, for his thesis entitled "Nicotinic Acid and its role in Nutrition".

Mr. K. Subba Rao, M.Sc., has been awarded the degree of Doctor of Science in consideration of his work on the problem of Hysteresis in Sorption. A decade ago, the non-coincidence of the sorption and desorption curves was a puzzle amongst scientists. Investigations by Dr. K. Subba Rao in the Chemistry Laboratory of the Central College, on a variety of adsorption systems, using the McBain-Bakr quartz fibre spring technique, have established the remarkable permanence and reproducibility of the Hysteresis Loop. A new method of studying hysteresis, called by the author "Scanning of the Hysteresis Loop" has yielded results which constitute convincing evidence of the role of cavities with constricted ends, in causing the hysteresis in sorption. The "drift" in the hysteresis loop is explained as being due to the widening of cavities and their necks and a diminution in the total cavity volume, caused by the coalescence of the particles of the porous system, on progressive sorptions and desorptions. The disappearance of the hysteresis loop in the case of organo-gels is due to the elasticity of these gels, which swell on the imbibition of solvating liquids. A study of the rates of sorption of water on different porous gels has yielded further striking evidence in support of the cavity concept of hysteresis.

The degree of Doctor of Science has been conferred on **Mr. M. R. Aswathanarayana Rao, M.Sc.**, in consideration of his work relating to the iodides and oxy-iodides of sulphur. In chemical literature, it is stated that the iodides and oxy-iodides of sulphur have no existence. By the new method developed by Dr. M. R. Aswathanarayana Rao at the Central College, it has been possible to prove beyond doubt that these iodides can be prepared under special conditions, though they are highly unstable. The principle of the method is to treat a dilute solution of the corresponding chloride (*e.g.*, sulphur mono-chloride) in carbon tetrachloride with dry potassium iodide, taking care to minimise the decomposing effect of light. An ingenious spectroscopic method of confirming the existence of the iodides has also been developed by the author. The presence of these unstable compounds in carbon tetrachloride solutions has been proved by a carefully conducted study of the hydrolysis of the iodides by alkali.

By the application of this method, the following compounds (1) Sulphur mono-iodide, (2) Sulphur di-iodide, (3) Thionyl iodide, (4) Sulphuryl iodide and (5) Selenium iodide have

been prepared. The method is general in its scope and can be applied in the preparation of many unstable iodides that have not been isolated hitherto.

Calcutta University.—(1) Dr. H. J. Bhaba, D.SC., has been appointed Special University Reader to deliver a course of ten lectures on "Cosmic Rays". The dates of the lecture will be announced later. (2) Mr. Manohar Ray, M.SC., has been admitted to the degree of Doctor of Science in consideration of his thesis entitled "Studies in Fluid Motion".

The laboratory glassware, manufactured by *Messrs. The Scientific Indian Glass Co., Ltd.*, Calcutta, made from neutral and resistant glass, has been on the market for some time. The neutral glass, designated at "**Sigcol**" glass, has been tested at the Government Test House, Alipore, and reported as satisfactory. Its linear coefficient of expansion is $4 \cdot 8 \times 10^{-6}$, loss on boiling with N.NaOH for 3 hours, 44·1 mg. per 100 sq. cm., and loss on boiling with constant boiling HCl for 3 hours, 0·47 mgs. per 100 sq. cm. According to tests carried out in the laboratory of Prof. J. N. Mukherjee, D.SC., University College of Science & Technology, Calcutta, *equilibrium water when kept in a flask for 24 hours does not suffer any change in specific conductivity.* It should thus satisfy most types of laboratory requirements. This pioneering venture in the manufacture of scientific glassware in India was started just two years ago and the well-known and enterprising firm, **Messrs. Adair Dutt and Co., Ltd.**, are the sole agents in India (except Bombay and Burma) from whom all relevant details can be had.

L & N Portable Universal pH Indicator.—The rapidity with which progress has been made in all branches of Science has been dependent upon the development of more accurate and more rapid methods of measurement of Physical quantities.

For several years **Leeds & Northrup Co.**, of Philadelphia, worked on pH Meters and ultimately constructed an instrument to meet the need for a compact, portable, Universal pH indicator. This instrument is accurate and direct reading not only with its own self-contained glass electrode but also with the quinhydrone, hydrogen or any other electrode following the Nernst equation.

Combining the accuracy and sensitivity of a laboratory instrument with the speed and convenience of a portable indicator, this Universal pH Indicator is entirely self-contained. It is obtainable in India from Messrs. *The Scientific Instrument Company, Ltd.*, Allahabad.

ASTRONOMICAL NOTES

Eclipse of the Sun.—A total eclipse of the Sun will occur on October 1. The path of totality begins in Columbia, South America, and passing through Brazil, the southern part of the Atlantic Ocean and South Africa ends in the Indian Ocean to the south of the island of Madagascar. The duration of totality in South Africa will be about four minutes. No phase of the eclipse will be visible in India.

Planets during October 1940.—Mercury will be low down in the western sky in the evenings and can be seen for a short while after sunset; on October 20, it will be at greatest elongation (24° 36′ East). Venus continues to be a morning star and is slowly approaching the Sun. Its brightness is decreasing, its stellar magnitude being − 3·6 at the end of the month. Mars is near the Sun in the morning sky and is still in an unfavourable position for observation.

Jupiter and Saturn continue to be apparently close together and present an interesting spectacle in the sky for almost the whole night, the two planets crossing the meridian about an hour after midnight. Both are bright, the magnitude of Jupiter is −2·4 and that of Saturn 0·1. A conjunction of the two occurs on October 11, Saturn being 1° 17′ to the south of Jupiter. Uranus is in Taurus and reaches the meridian about two hours after midnight; it is about four degrees south of the well-known cluster Pleiades. Two occultations of stars by the Moon may be noted as likely to be of some interest—β Capricorni (magnitude 3·2) on October 9, and σ Leonis (3·8) on October 26.

T. P. B.

MAGNETIC NOTES

Magnetic conditions during August 1940 were less disturbed than those in the preceding month. There were 6 *quiet* days, 23 days of *slight* disturbance and 2 of *moderate* disturbance as against 11 quiet days, 16 days of slight disturbance, 2 days of moderate disturbance and 2 of great disturbance during August 1939.

The quietest day during August 1940 was the 30th and the day of largest disturbance was the 3rd. The characters for the individual days are shown below.

Quiet days	Disturbed days	
	Slight	Moderate
16, 21, 24, 25, 29, 30	1, 2, 4–8, 10–15, 17–20, 22, 23, 26–28, 31	3, 9

There were no magnetic storms during the month of August 1940, while there were three storms (two of great intensity and one of moderate intensity) during August 1939. The mean character figure for August 1940 is 0·87 as against 0·77 for August of last year.

M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of August 1940 one great, three moderate and one slight earthquake shocks were recorded by the Colaba seismographs as against two slight ones recorded during the same month in 1939. Details for August 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Remarks
1940		H.	M.	(Miles)		
August 1 ..	Great	20	38	3990	45° N., 141° E., near Hokkaido Island, Japan	Reuter's news: 1300 fishing boats washed away by a tidal wave off the western coast of Hokkaido Island and much loss of life feared.
,, 13 ..	Moderate	21	07	3760	Near 34° N., 133° E., in or near Southern Japan	
,, 22 ..	Moderate	8	57	6570	Near 48° N., 165° W., to the south-east of Aleutian Islands	
,, 29 ..	Moderate	13	33	1630		
,, 30 ..	Slight	20	32	1870		

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 88, Nos. 4562–65.

"Journal of Agricultural Research," Vol. 60, Nos. 2–7.

"Agricultural Gazette of New South Wales," Vol. 41, Pts. 7–8.

"Indian Journal of Agricultural Science," Vol. 10, Pt. 3.

"Biochemical Journal," Vol. 34, Nos. 5–6.

"Journal of the Institute of Brewing," Vol. 46, Nos. 6–7.

"Contributions from Boyce Thompson Institute," Vol. 11, No. 3.

"The Journal of Chemical Physics," Vol. 8, Nos. 6–7.

"Journal of the Indian Chemical Society," Vol. 17, No. 5.

"The Calcutta Reiew," Vol. 76, Nos. 1–2.

"Experiment Station Record," Vol. 82, Nos. 5–6.

"Indian Forester," Vol. 66, Nos. 8–9.

"Indian Forest Records," Vol. 6, No. 3.

"Transactions of the Faraday Society," Vol. 34, Nos. 230–31.

"Indian Farming," Vol. 1, Nos. 6–8.

"Genetics," Vol. 25, No. 1.

"Transactions of the Geological, Mining and Metallurgical Society of India," Vol. 11, No. 4, and Vol. 12, No. 1.

"Bulletin of the Indian Central Jute Committee," Vol. 3, Nos. 4–5.

"University of Illinois Bulletins," Vol. 37, Nos. 27–29.

"Review of Applied Mycology," Vol. 19, Pt. 6.

"Scripta Mathematica," Vol. 6, No. 4.

"Indian Medical Gazette," Vol. 75, No. 7.

"The Bulletin of the American Meteorological Society," Vol. 21, No. 5.

"Journal of the Mysore University," Vol. 1, Pts. 1–6.

"The Merck Report," Vol. 49, No. 3.

"Journal of Nutrition," Vol. 19, No. 6, and Vol. 20, No. 1.

"American Museum of Natural History," Vol. 45, No. 1.

"Nature," Vol. 145, Nos. 3683–87.

"Occasional Notes (Royal Astronomical Society)," No. 8.

"Indian Journal of Physics," Vol. 14, Pt. 2.

"Proceedings of the Royal Netherlands Academy, Amsterdam," Vol. 42, Nos. 7–9.

"Proceedings of the Royal Society of Edinburgh," Vol. 59, Pt. 3, and Vol. 60, Pt. 1.

"Journal of Research (National Bureau of Standards)," Vol. 24, Nos. 1–5.

"Canadian Journal of Research," Vol. 18, No. 6.

"Sky," Vol. 4, Nos. 8–9.

"Lingnan Science Journal," Vol. 19, No. 3.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 10, Pt. 2.

"Science Forum," Vol. 5, No. 2.

CATALOGUES

Fisher Scientific Company (Castaloy Laboratory Appliances).

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

July 1940. SECTION A.—B. K. NANDI: *Experiments on the synthesis of compounds related to cinchonine and quinine.*—Some quinoline compounds that are structurally related to quinine and cinchonine have been synthesised starting from ethyl quinoline-3-carboxylate and ethyl 2-methoxy quinoline-3-carboxylate respectively. Although it has been found that these new series of compounds are effective against paramæcia, the cinchonine related series have however proved ineffective against avian malaria. T. VIJAYARAGHAVAN: *On decimals of irrational numbers.* BAWA KARTAR SINGH AND M. K. SREENIVASAN: *The kinetics of mutarotation of oxymethylene-*d*-camphor—Part II.* Traces of moisture accelerate the chemical changes involved in mutarotation catalytically. S. S. PILLAI: *On Waring's problem* $g(6) = 73$. S. S. PILLAI: *Waring's problem with indices* $\geqslant n$. R. D. DESAI AND (MISS) K. S. RADHA: *Studies in the Friedel-Crafts reaction—Part V. The action of acetic anhydride and benzoyl chloride on β-methyl resorcylate.* M. W. CHIPLONKAR: *Measurement of point discharge current during disturbed weather at Colaba.*—During the year there was an outflow of 30·6 millicoulombs of positive electricity from earth to air, and an inflow of 10·4 millicoulombs from air to earth. HANSRAJ GUPTA: *On the absolute weight of an integer.* S. S. PILLAI: *A note on Gupta's previous paper.* N. JAYARAMAN: *Alteration of tremolite to talc in the dolomite marbles of Yellandu, Warangal District (Hyderabad, Dn.).* During the alteration (*a*) almost all the calcium is lost, (*b*) water of constitution and alumina accumulate and (*c*) ferrous iron gets fully oxidised. It is suggested that meteoric solutions and atmospheric action were mainly responsible for the alteration. N. A. SHASTRI: *Some results involving Angelescu's polynomial* $\pi_n(x)$. C. V. RAMAN AND N. S. NAGENDRA NATH: *Quantum theory of X-ray reflection and scattering. Part I. Geometric relations.*—When X-rays fall upon a crystal, the characteristic vibrations of the crystal lattice may be excited thereby, in much the same way as in the phenomenon of the scattering of light in crystals with diminished frequency, the excitation being a quantum mechanical effect. B. DAYAL SAKSENA: *Analysis of the Raman and infra-red spectra of* α*-quartz.*—On the basis of the known crystal structure of quartz and the character table for the relevant point group, the symmetry modes of vibration of the atom groups in the unit cell are derived and geometrically represented, and their appearance in the Raman effect and in infra-red absorption is discussed in detail. These theoretical deductions are compared with an extended series of experimental studies on scattering in quartz, and the already known results of infra-red measurements.

July 1940. SECTION B.—I. FROILANO DE MELLO AND JONES DE SA VIEGAS: *The phenomena of dissociation into S and R forms observed among bacteria do also occur in yeast cultures.* M. A. BASIR: *Nematodes parasitic in Indian-cockroaches.* I. FROILANO DE MELLO: *A report on the characters and identification of the yeasts living in commensalism in the intestine of some laboratory animals.*

August 1940. SECTION A.—C. V. RAMAN AND P. NILAKANTAN: *Reflection of X-rays with change of frequency.—Part IV. Rock-salt.*—The experimental results support the expectation that the oscillation of the interpenetrating lattices of sodium and chlorine ions should vary the structure amplitudes of the crystal in such a way that the halved spacings which give strong unmodified reflections should also give strong modified reflections in the same order of relative intensity. B. K. SINGH AND A. B. LAL: *Studies on the dependence of optical rotatory power on chemical constitution—Part XVIII. The rotatory dispersion of stereo-isomeric 3.nitro-o-toluidino-, 5.nitro-o-toluidino-, 2:3-toluylenebisamino- and 2:5-toluylenebisamino-methylenecamphors.* S. S. PILLAI: *On normal numbers.* M. PRASAD AND S. S. DHARMATTI: *Molecular structure of some selenium compounds determined by magnetic method.* Se_2Br_2, Se_2Cl_2, H_2SeO_3, $Ag\,SeO_3$ and $SeOCl_2$ have been studied. S. S. PILLAI: *On a linear diophantine equation.* S. S. PILLAI: *On Waring's problem with powers of primes.* RAM BEHARI: *A theorem on normal rectilinear congruences.* P. RAMA PISHAROTY: *The Young's modulus of diamond.* The modulus in any direction lying in the octahedral plane is $5 \cdot 5 \times 10^{12}$ dynes/cm.^{2} The measurements were made by an improved "scale and telescope" method of Voigt. S. S. DHARMATTI: *Molecular structure of some tellurium compounds determined by magnetic method.* H_2TeO_3, $TeCl_2$, $TeBr_2$, $H_2TeO_4 2H_2$, $(CH_3)_2TeI_2$, $(CH_3)_2TeCl_2$ have been studied. K. S. K. IYENGAR: *A property of integral functions with real roots and of order less than two.* B. K. SINGH AND A. B. LAL: *Studies on the dependence of physiological action on chemical constitution—Part I. Difference in odour of* d-, l-, and dl- *derivatives of amino- and bisamino-methylenecamphors.*

August 1940. SECTION B.—T. S. RAGHAVAN AND K. R. VENKATASUBBAN: *Studies in the South Indian Chillies—I. A description of the varieties, chromosome numbers and the cytology of some X-rayed derivatives in* Capsicum annuum *Linn.* J. J. ASANA: *Chromosomes of* Typhophtera donovani *don. (Tettigonidæ).* B. P. PAL AND T. NARAYANA RAO: *Ovule Mortality in Gram* (Cicer arietinum L.). SHRI RANJAN: *A Preliminary note on the X-ray Mutants of Pusa* (52) *Wheat.*

Indian Association for the Cultivation of Science *(Proceedings)*:

April 1940.—N. BAGCHI: *The secondary K-Absorption Spectra of Sulphur.* S. DEB: *A note on the origin of the D-layer.* S. S. BANERJEE

AND A. S. RAO: *Production of Ultra-high Frequency Radio Waves by Electric Oscillations.* S. P. GHOSE: *Early Morning Variation of Ionisation and the True Height of Region F of Ionosphere.* M. RAMA RAO: *A Relation between Velocity of Sound in Liquids and Molecular Volume.* K. C. KAR: *The Theory of Compton Effect.* BISHNUPADA SAHA: *Rotational Raman Scattering in Liquid Oxygen.* S. P. RANGANADHAM AND M. QURESHI: *Magnetic Susceptibilities of Solutions of Sodium and Potassium Nitrates.* I. RAMAKRISHNA RAO AND Y. PARAMASIVA RAO: *Mutual Influence of Water and Heavy Water.* N. RAJESWARA RAO: *Electrolytic Dissociation in Sulphuric Acid as studied by Raman Effect.* CHANDRASEKHAR GHOSH: *Studies on some Indian Vegetable Oils—Part V. Temperature Effect on Gas Absorption and other Physical Properties.* HARIBANSH NARAYAN YADAV: *A Simple Laboratory Method of Producing Continuous Ultra-violet Light.*

Indian Chemical Society:

May 1940.—HANS RAJ KAPUR, KIDAR NATH GAIND, KARTAR SINGH NARANG AND JNANENDRA NATH RAY: *A new formula for chaksine, the alkaloid of* Cassia absus *and some experiments on its constitution.* B. K. NANDI: *Synthesis of Benzonicotine.* R. CHATTERJEE: *The alkaloid of* Berberis umbellata—*Part I. Isolation and examination of Umbellatine.* NRIPENDRA NATH CHATTERJEE AND GIRINDRA NATH BARPUJARI: *The influence of substitution on the formation of derivatives of α-Hydrindone and α-Tetralone. Synthesis of 1: 2: 3: 4-Tetrahydronaphthalene-1: 2-dicarboxylic acid.* S. VENKATARAMAN: *Compound formation in solutions—Part I. Pyridine and acetic acid.* W. V. BHAGWAT: *The reaction between aqueous iodine and sodium formate.* SANTI RANJAN PALIT: *Physical chemistry of resin solutions—Part I. Anomalous solubility of shellac and other resins in organic solvents.* K. P. BASU AND M. C. MALAKAR: *Iron and Manganese requirements of the human adult.* G. C. ESH AND S. S. GUHA-SIRKAR: *An investigation in soil and peat humic acids—Part I. Isolation and purification of the acids.* A. C. MAJUMDAR: *The effect of the injection of cobra venom on the ascorbic acid content of different tissues of the guinea-pig.* G. GOPALA RAO AND W. V. SUNDARA RAO: *Mechanism of* the microbiological oxidation of ammonia—Part III. M. Q. DOJA: *The cyanine dyes of the pyridine series.* A. L. SUNDARA RAO: *Distribution of trace elements in biological material.* S. K. MITRA: *A note on the isolation of anti-anœmic factor present in raw liver.* HEMENDRA NATH CHATTERJEE AND SURATH MOHAN GHOSH: *A note on the Lecithin content of the blood of Indian woman in normal condition and in pregnancy.* HEMENDRA NATH CHATTERJEE AND S. SEN: *A note on some of the electrolytes of the blood serum in normal Indians.* DURGA PADA CHATTERJEE: *A rapid method of estimating Tungsten in Tungsten steels.*

Royal Asiatic Society of Bengal:

August 5, 1940.—E. O. MURRAY: *Ancient workers of western Dhalbhum.* An interesting account of the copper mine working of the ancient people of the western Dhalbhum perganah, in the district of Singhbhum, in Bihar, has been provided. Remains of the ancient copper workers are numerous in the shape of countless working dumps and slag heaps testifying to their industry. Slag heaps and the remains of old clay furnaces lie all around and testify to a considerable output of copper at these points. The process of smelting was more or less the same as at present day, air being supplied by foot-worked leather bellows to clay furnaces about three feet high. R. RAKSHPAL: *Post-embryonic development of the respiratory system of* dialeurodes eugeniæ *Maskell (Homptera aleurodidæ) together with preliminary observations regarding the mechanism of respiration in the different instars.*

Meteorological Office Colloquium, Poona:

July 16, 1940.—L. A. RAMDAS: *A simple method of estimating the thermal conductivity of air near a water surface.*

July 23, 1940.—V. M. GHATAGE: *Model experiments on the relative motion of fluids of different temperatures.*

July 30, 1940.—K. NAGABHUSHANA RAO: *Atmospheric oscillations.*

August 13.—C. W. B. NORMAND: *The study of eviction and allied phenomenon with the help of Tephigrams.*

August 20.—S. V. CHANDRA SEKHARAIYA: *Physical principles of Radio Transmitters and Receivers.*

August 27.—K. R. RAMANATHAN: *Evaporation from water drops.*

Geological, Mining and Metallurgical Society of India:

The two recent numbers (Vol. 11, No. 4 and Vol. 12, No. 1) of the *Quarterly Journal of the Geological, Mining and Metallurgical Society of India* contain a number of short papers of varied interest. In the former, Mr. R. D. Godbole gives a brief account of the ground water conditions around Phonda in Deogad Taluq of Ratnagiri District and adjacent areas; and Messrs. K. K. Sen Gupta and J. Sen Gupta describe the Magnetite deposits near Daltonganj, with a note on their electric smelting. In the latter number, Mr. P. K. Chatterji writes about the economic geology of Jamalpur and its neighbourhood in Bihar. The paper on the Cherra-Nummulitic sequence near Cherrapunji by Mr. K. L. Das discusses the stratigraphical relationships of the Cherra sandstone to the underlying Cretaceous on the one hand, and the overlying Nummulitics on the other—thus throwing some light on the controversy regarding the exact age of the Cherra sandstone. Mr. K. Satyanarayana draws our attention to the occurrence of graphite at Majjivolum near Bissamcuttack Railway Station.

Bulletin No. 4 published by the Society deals with "The economic aspect of the Boulder bed in Radhaballavpur near Salanpur in Burdwan District." In this paper Messrs. K. K. Sen Gupta and J. Sen Gupta, after giving a brief account of the geology of this area, refer to the economic value of the gravels and fireclays found therein, giving some facts and figures.

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CURRENT SCIENCE

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AUTOMOBILE INDUSTRY IN INDIA

THE question of establishing an automobile factory in India is just a part of the general scheme of industrialising the country, and, if it is agreed that the development of all the available material resources of this great sub-continent is desirable and necessary for the promotion of the prosperity and the well-being of the Empire, it is inconceivable why the modest proposals for the inauguration of a motor factory in Bombay were discouraged. It will be remembered that in connection with framing the outline of the project, Sir M. Visvesvaraya had investigated the possibilities of this new venture in all its detail, by visiting a large number of automobile factories in Europe and America, and by consulting with their directors and technical experts. The report that he prepared after exhaustive enquiry, revealed the fact that practically all the experts consulted favoured the project, by offering active support and co-operation. It was a grave misfortune that, while the report was being sympathetically considered by the promoters of the scheme, they appear to have been suddenly seized with a spirit of pessimism in respect of the success of the proposals formulated in the report, and that they were almost inclined to believe the misleading doctrine that India would do better to buy foreign motor vehicles than build them in her own factories. The establishment of a large industry, such as the one Sir M. Visvesvaraya was contemplating, must necessarily affect vested interests and must even provoke a certain measure of hostility, but what is puzzling is that the hard-headed business men, who take a practical and a long-range view of industrial concerns,

should succumb to the blandishments of false and futile economic philosophy. In 1936, efforts were made to enlist the sympathy and the active support of the Government of Bombay and the Government of India. The Government of India were profuse in their sympathy, but adhered to the policy of discriminating protection for Indian industries, enunciated by the Fiscal Commission of 1921–22 and in pursuance of this policy the Imperial Government could offer no assistance to "an industry that was not started" and could therefore make no promise for the purchase of its products. The Congress Ministry, then in power in Bombay, however, offered provisionally a guarantee of 3 or 3·5 per cent. interest on a capital issue of Rs. 150 lakhs for the industry for a period of ten years. Before the concession could be finally sanctioned, the Congress Government went out of office.

If the survival value of a nation is measured by the encouragement that the Government gives to applied science and to industries, then, in all conscience, India's ability to survive in a world of competition looks terribly small. There are obviously formidable obstacles in the way of promoting both. Some of the obstacles lie in India's social system, but the majority of them are due to our own want of initiative, enterprise and solid co-operation. If, in addition to these fairly surmountable impediments, we encounter the unhelpful attitude of the Government, Indian large-scale industrial enterprises must, for a long time, remain in a sub-conscious stage. It was just here that the Congress Government could have rendered the greatest service to the country, had it not in such excessive haste, shed the reins of office. We may be almost certain that, if the Congress from its position of official power had applied its mind to the matter of collecting funds for war effort, fairly colossal amounts could have been raised. One of the uses to which a certain percentage of such funds could be applied would be the assistance rendered for the establishment of "key industries" in India. The Congress Ministries in the seven provinces in their combined capacity could have exercised their power of persuasion so as to secure for the new industries the countenance and encouragement of the Government of India. We have willingly sacrificed great opportunities of service.

While the Government of India is slow to accord its support to the scheme formulated for the institution of an automobile factory in Bombay, attention may be drawn to the extent to which the Commonwealth Government of Australia has lent encouragement to a local Company "before it proceeded to make the necessary arrangements to establish the industry in Australia". On December 19th, 1939, the Australian Parliament passed an Act known as "The Motor Vehicle Engine Bounty Act", which enabled the Government to enter into an agreement with the newly formed Company, the Australian Consolidated Industries, Ltd., providing for the payment of a bounty of £1,500,000 for the first 60,000 vehicle engines manufactured by the Company. It is worthwhile to reproduce here some of the main provisions in the agreement which would throw into relief the unsympathetic tenderness and unfriendly interest evinced by the Government of India towards such enterprises.

"Two-thirds of the paid-up value of shares should be owned by subjects resident in Australia.

"The Commonwealth Government will safeguard the interests of the Australian Company against the establishment of rival foreign companies.

"Government will use its power of import control to counteract any foreign trading methods by oversea interests in selling competitive vehicles in Australia.

"For five years from commencement of manufacture, the Commonwealth Government will purchase a substantial portion of its requirements from the proposed factory.

"Government will admit free of import duty such machinery as cannot be conveniently manufactured at the outset within a reasonable time.

"The Commonwealth Government will be prepared to examine upon request the measure of tariff or other assistance needed for import of any special automobile parts."

The Government of India no doubt is equally generous in the reverse direction in granting favours to foreign firms, but obstinately alert in withholding them from indigenous enterprises. In August 1940, the Associated Press announced from Simla the arrangements made by the Government of India with the local branches of the two American Motor Companies for obtaining the required number of motor vehicles for military purposes.

"The two great American Motor Companies, General Motors and Fords, which possess large assemblage and body-building plants in India, are co-operating with the Government in the production of vehicles for the Indian Army. Although it is not possible to state the numbers or types which are in production at these plants, it can be said that the present initial expansion of the Indian Forces involves an increase of between twenty and thirty thousand in the number of vehicles required by the Army. All these are divided into no less than 56 types. To assist in coping with these requirements, the American concerns have recently considerably extended certain sections of their works and these extensions, it is understood, will be specially devoted to urgent Government work."

Big questions of far-reaching significance will naturally arise from a consideration of the respective attitudes of the Commonwealth Government of Australia and of the Government of India, and we do not propose to enter the field sowed with salt and mustard powder. We may, however, pertinently ask whether, in case 50 per cent. of the facilities, which the Australian Parliament granted to the Australian Consolidated Industries, Ltd., in 1939, had been given to the Bombay Scheme in 1936, by the Government of India, the projected Indian Motor Compay would not be in a position to supply to the Government 50 per cent. of the "twenty and thirty thousand vehicles" which have been now ordered exclusively from foreign firms. Is the policy of discriminating protection so inflexible that it can afford to be stolidly and permanently indifferent to the prosperity of Indian industries; and have the Government of India no power to relax its rigours or render it capable of assisting large-scale industries? It will be interesting to read the report of the Roger Commission on the effects of this policy of discriminating protection on the destiny of India as an industrial country. We neglect the Indian cow, but wish to milk the foreign bull. A complete reorientation of the policy of the Government of India seems imperative, and, if this change does not occur now, we are afraid we will have to be "without industries and without applied science", nobody knows how long.

In the brochure before us, we notice that its author has made a fresh appeal to the Government of Bombay and the Government

of India for support and co-operation. From the former he wants confirmation of the guarantee of 3.5 per cent. on capital outlay, provisionally promised by the previous Congress Government, and from the latter, an assurance that the project may be treated as a war measure, capable of manufacturing and supplying army vehicles, that they might place with the projected local factory a substantial part of their order and grant reasonable tariff concession in connection with imports of parts and raw materials required by the factory. The very reasonableness and moderation of the appeal must be its best recommendation. Can not India have at least Industrial Swaraj?

It is unnecessary to emphasise the importance of an automobile industry to India, and yet India will not be wanting in apple-pie critics who will oppose every species of change or reform in the existing state of affairs. India suffers from three obsessions, Goats' Milk, Red Tape and Communal Adenoids. Any enterprise in any field, however innocuous and important, is easily brigaded under one of these political ingredients.

The tragic events of the War which have placed the Empire in a critical situation are attributable to the entire lack of scientific thought and scientific mode of approach and solution of national problems. We shall not have exhausted the resources of science by merely applying its knowledge to the present practical problems, but we ought to be able with its aid to predict future problems and to impress its services for their solution. It was in this spirit that Sir M. Visvesvaraya conceived his project of an automobile factory in India in 1936, which while rendering service in peace time, could be utilized for war purposes when such demands were made on the industry. It is not surprising that the Government have dealt with the proposal in their traditional grand style. In war, more particularly in its acute phases, such as those in which we find ourselves at the present moment, it might be supposed that temporary make-shift arrangements are what are most urgently required, and some may even be disposed to think that the time is inopportune for the inauguration of large-scale industries. According to such views, it would be safest for all concerned to follow traditional methods of thought and action. But wars shatter traditional methods because they introduce into our political, social and economic institutions unfamiliar and devastatingly new problems. It is only on a basis of quantitative knowledge that industrial problems can be formulated and that the need for the institution of new industries can properly be determined. The problem presented by Sir M. Visvesvaraya's brochure is definite and simple, and it is hoped that the Governments, to which appeals for support and encouragement for the projected factory have been preferred, will not be lacking either in ability or willingness to remove delays of industrial advancement and economic development in India. "Policies" are sacred, and they acquire more sanctity by furthering the industrial prosperity of the People. "Vested interests" are serious and they earn better respect by not injuring national interests.

TUBERCULOSIS IN INDIA

THE *Indian Medical Gazette* has issued a special tuberculosis number this month. In the preparation of this number and in the selection of contributions for inclusion, the editor has had the assistance of an editorial committee of the Tuberculosis Association of India. The contributors include many of the best-known tuberculosis workers in India and the contributions deal with a number of aspects of this subject which is so vital to India's health, but the majority are clinical articles written by specialists for the benefit of the practitioner.

Two important papers deal with conditions that may easily be mistaken for tuberculosis but are not tuberculous in origin; Dr. Ukil writes on chronic infections (non-tuberculous) of the lung, and Dr. Frimodt-Möller and Mr. Barton describe a condition which they call 'eosinoplile lung' that simulates tuberculosis very closely, particularly in its X-ray manifestations, and leads to much mis-diagnosis. This latter condition seems to be particularly prevalent in India and has not been described in other countries.

The sufferer from tuberculosis is not immune from other chronic diseases and *vice versa*; the combination of two diseases usually adds considerably to the risks associated with either of the diseases singly. Pulmonary tuberculosis associated with diabetes is an example. Dr. Benjamin and Verghese point out that the prospects of the patient is not so fatal as it was a few years ago before insulin and many of the more successful measures of dealing with diabetes were introduced and the immediate results in their hands have been comparatively good. Dr. Jones, of the Wanless Tuberculosis Sanatorium, describes the treatment of spontaneous pneumothorax, a common 'accident' in tuberculosis, and Dr. Samuel, of the same institution, that of tuberculous empyema. Other articles are on diet in tuberculosis and on tuberculosis in women with special reference to the question of tuberculosis and pregnancy.

On the subject of tuberculosis organisation there are two particularly valuable papers, one on the control of tuberculosis in the U.S.A., by Dr. Shah of the Public Health Department of the Punjab, who has recently spent some time in America, and the other, by Dr. Frimodt-Möller, the Medical Commissioner of the Tuberculosis Association of India. There is much inspiration to be gained from America's experience and much to be learnt, but there is little that can be translated directly into terms suited to Indian conditions. Dr. Frimodt-Möller on the other hand outlines a policy that can be adopted in India immediately and is yet capable of expansion.

Finally, the editor, Dr. L. E. Napier, emphasizes the importance of the adoption in India of a fixed policy, as he points out that vacillation shakes the confidence of the lay public without whose wholehearted co-operation any policy will fail. He considers that we know enough about tuberculosis in general, and conditions in India in particular, to frame such a policy, whilst at the same time making allowance for future advances in our knowledge and improvement in local conditions. He supports Dr. Frimodt-Möller's recommendations with the proviso that the establishment of industrial colonies for ex-patients is perhaps not really suited to Indian conditions as they exist to-day.

This is the fifth year in succession that the *Indian Medical Gazette* has published a special tuberculosis number. This number constitutes a valuable contribution to the subject and will be found of great interest, not only to medical men but to all interested in this aspect of the welfare of India and her people.

INDIAN AVIATION MAPS

THE writer of the article, "Indian Aviation Maps" in our May (1940) number was probably unaware that the style of the "Carte Internationale du Monde" series of maps is regulated by an International Committee, and that departures from the prescribed style are discouraged.

Another International Committee selected the above series of maps as the basis for a series of Aviation maps of the world.

In the Aviation series certain modifications are permitted; but, owing to the war, progress on this series has been and is likely to be slow.

PRESERVATION OF SALT-AFFECTED MURAL PAINTINGS FROM ANCIENT SHRINES IN CENTRAL ASIA

BY

MOHAMMAD SANA ULLAH

(Chemical Laboratory, Archæological Survey, Dehra Dun)

THE decay of exhibits charged with soluble salts is a well-known phenomenon in museums, but it is sometimes extremely difficult to devise a remedy to counteract this evil. An acute problem of this kind has been offered by the mural paintings which are on exhibition in the Central Asian Antiquities Museum at New Delhi.

These paintings were discovered by Sir Aural Stein in ancient Buddhist shrines in the ruins of Central Asia, in the course of his expeditions extending over the periods 1906-08, and 1913-16. The paintings have been executed on mud plaster which is finished with a fine and smooth layer (*intonaco*) of the same material and a thin wash of burnt gypsum, made into cream with water, has been applied over this surface in order to form the painting ground. The colours employed are gypsum, red and yellow ochres, lamp black, malachite, terre verte and *lapis lazuli*, which were evidently mixed with a suitable medium (glue or gum), and applied with brushes on this ground which might have been still moist, or dried off completely.

In the process of mounting, as carried out in this museum, the slabs bearing the paintings were placed face down on a glass plate and the superfluous mud backing was carefully scraped off until the plaster was left only ⅛″ to ¼″ thick, *i.e.*, barely sufficient to hold the surface intact. Now the slabs were strengthened by the application of a thin layer of plaster of Paris cream on the backside. Several continuous slabs were then brought together in proper order to form a panel of convenient size, and an aluminium angle frame of suitable size, with expanded aluminium netting stretched across it, was placed over these slabs in the correct position. Sufficient plaster of Paris cream was then poured all over the slabs to cover the meshes until the whole assemblage was embedded in a uniform layer of the plaster. When the plaster had set hard the whole was lifted up from the glass plate as one unit. The section of such a unit is shewn in Fig. 1. For exhibition, these aluminium

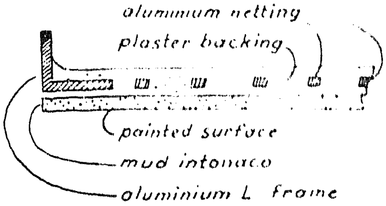


FIG. 1

frames were arranged in proper order and hung against the walls of the museum, by means of adjustable hooks resting on fixed iron chanelling; so that an empty space, about 2″ wide, was left between the wall and the panels. The paintings have been finally encased in wooden almirahs with glazed doors in front. After the lapse of several years signs of decay developed on some of these paintings, which began to spread and affect several more in a short time. The decayed plaster was examined and found heavily charged with sodium chloride and sodium sulphate. There is no doubt that the salts were present in the original plaster, since the ruined sites (whence these paintings were recovered) are situated in very saline areas. The decay of the surface was caused by a continuous cycle of solution and crystallization of the salts, which is set up by variation in atmospheric humidity. In the wet season, when the humidity remains excessive over long periods, the salts remain in solution and do not get a chance to crystallize. However in the dry weather the humidity of air remains low during the day; but it may rise up to the saturation point at night with the fall of temperature. Therefore the cycle is repeated with great frequency and rapid decay occurs. This explains the marked intensity of decay due to injurious salts, in the cold season.

The atmospheric conditions prevailing in the museum galleries, also cause the salts to move out and concentrate gradually on the painted surface, which is consequently subjected to severe deterioration. In the rainy season, the exposed walls as well as the floors of the museum absorb appreciable

amounts of water which is given off to the air slowly for a long time afterwards. Therefore, the 2″ airspace (which exists between the walls and the picture panels), must have remained saturated with moisture for sometime after the rains when the humidity of atmosphere in the gallery had fallen low. In other words, necessary conditions for the establishment of a humidity gradient across the picture panels must have prevailed in certain parts of the year, which would force the salts in the panels to move out and concentrate on the painted surface.

Before going further it seems desirable to explain the principle underlying the movement of salts in porous bodies under the influence of a humidity gradient. It is well known that if one side (A) of a porous partition is exposed to higher atmospheric humidity than the other (B), then movement of water vapour takes place through the partition from surface A to surface B. Suppose the porous partition be impregnated with soluble salts and the Relative Humidity on the surface A is sufficient to cause the salts to deliquesce while that (Relative Humidity) on B is low enough to cause their efflorescence, then the salts will go into solution at the surface A, spread through the material by capillary action, and crystallize out gradually at the surface B. This process will go on as long as the humidity gradient is maintained. In other words the salts also will move from A to B and concentrate at this surface.

The material of the *intonaco* (*i.e.*, mud) and tempera style of the paintings preclude the application of wet paper pulp or soaking in water, which constitute the common methods for the elimination of soluble salts from more rigid materials, such as terracotta, stone, etc. Coating with cellulose acetate and vinyl acetate solutions were tried but failed to arrest the process of decay, due to the fact that the thin films are not impervious to moisture. After much experimentation it was decided to break the concentration of the salts on the soft painted surface and to induce them to concentrate on the surface of the plaster backing instead by the reversal of the humidity gradient. In actual practice, the treatment of these salt-affected panels has been carried out in a specially designed apparatus, named 'Humidity Chamber', which is illustrated in Figs. 2 and 3. This device consists of a

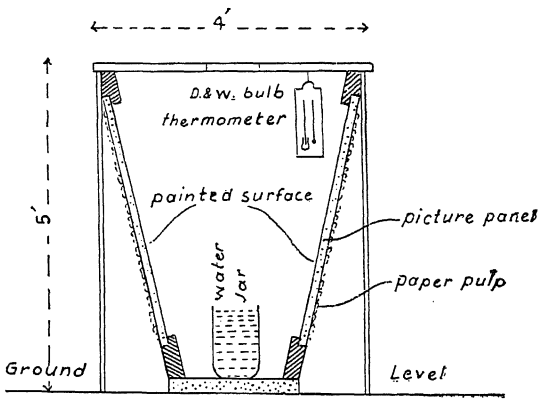
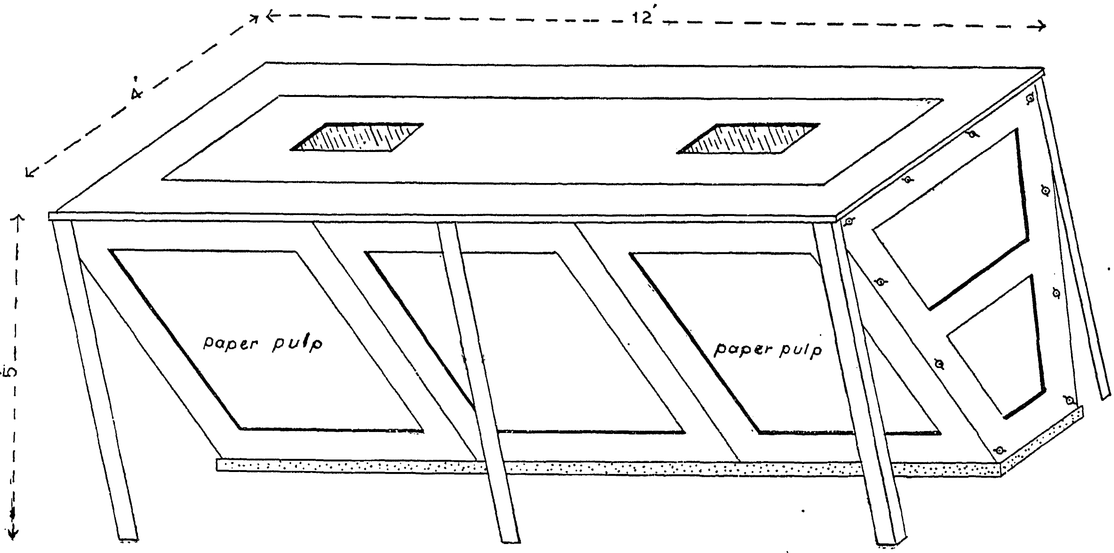


FIG. 2



skeletal frame of L-iron, having a trapezoidal section, which is supported on six iron uprights fixed in the ground. The top is covered by a wooden lid provided with two glazed windows, which is fixed down by means of fly-bolts and nuts. The flanks of the chamber are also provided with wooden frames, which can be partitioned off into two or more rectangular sections for the insertion of wooden adapters of suitable sizes. A number of frames bearing the paintings are secured to the sides of the chamber, with their painted surface inside, by screwing down wooden batons over them while the joints are rendered tight by means of felt packing. The front and back ends of the chamber are provided with glazed doors which can also be closed tightly by means of fly-bolts and nuts. A number of glass jars containing water are kept inside the chamber to humidify the air. Dry- and wet-bulb thermometers are suspended inside and outside, to indicate the relative humidities respectively. The slanting position of the panels helps to retain any fragments that may have loosened in the process of decay. The Relative Humidity inside is kept above 85 per cent.

After a week or so, paper-pulp of the consistency of porridge is applied to the outer (plaster) surface of the panels until a uniform layer ½″ thick has been laid all over it. The pulp generally adheres well but if the surface of the plaster is smooth it will tend to fall off. Therefore it will be necessary to keep the pulp in position by propping it at several points with the aid of flexible sticks, or, the whole surface may have to be pressed down by means of galvanized wire-netting of wide mesh fixed tightly over a wooden frame. Sometimes mildew develops in the pulp which will affect the paintings also. In order to counteract this danger it is desirable to sterilize the chamber by heating a quantity (½–1 oz.) of thymol inside, at intervals. Coating with thymol solution in alcohol was not found to be effective. However, the most effective remedy consists in the addition of a little carbolic acid to the paper-pulp mix-up.

The Humidity Chamber having been properly closed, the layer of the pulp is allowed to dry off, which takes a week or more, when it is removed carefully with the aid of a knife's point. Six-inch square specimen of the dried pulp is cut up, soaked in distilled water and its salt contents are estimated in a colorimeter. The applications of paper-pulp are repeated until mere traces of the salts can be detected. The panels are now removed from the chamber and the painted surface is impregnated with 5% vinyl acetate solution in toluene, until it has been strengthened sufficiently. Finally, the surface is pressed down gently with hot iron. A few typical examples of the analytical results are given below:

Grams of sodium chloride found in one square foot area of the dried paper-pulp, in successive applications

Specimen	Paper-pulp applications							Remarks
	1	2	3	4	5	6	7	
(a) Panel Gha ..	10·0	2·4	1·0	0·43	0·72	0·38	0	Highest concentration found
(b) Panel M.C. 06 ..	2·2	0·7	0·13	tr.				
(c) Panel M.C. 111, 01 ..	1·1	0·67	0·4	0·043				
(d) Panel Kao 11·03 ..	?	?	0·25	0·40	0·64	0·30	0	
(e) Panel Bez XIII *(a)*	0·69	0·24	0·32	0·11				
(f) Do. *(b)*	0·80	0·14	0·13	0·10				

Finally it may be mentioned that this process works very slowly and takes several weeks to bring down the concentration of salts to a small fraction.

ALGAL INVESTIGATIONS IN THE BOMBAY PRESIDENCY

BY
S. C. DIXIT
(*Wilson College, Bombay*)

THE history of the beginning of scientific exploration and recording of the plants in the Bombay Presidency commences with the arrival of the Portuguese at Bassein in the Island of Salsette about 1838 A.D. In those early days the object of botanical researches was to collect plants for the economic uses. A physician, named Garcia d'Orta has recorded some well-known medicinal and economic plants of this region. The man who materially laid the foundation of Systematic Botany of the Bombay Presidency was John Graham, a Deputy Postmaster-General. He published a "Catalogue of Plants Growing in Bombay and its Vicinity" in 1839. Thereafter, during the last hundred years the flowering plants have been investigated by several successive workers. But the lower plants and specially the algæ practically remained unnoticed for a long time. The systematic study of the Cryptogams is in fact comparatively a later step in the field of botanical research. The second half of the last century was the period of serious algological studies. The fields of the pioneer workers on Indian algæ were mostly outside this province.

The oldest record of algal collection from the Bombay Presidency is that of *Nitella acuminata* Br. and *Nitella dispersa* Br. made by Stokes in 1847. A paper on some Volvocales from Bombay was published by Carter in 1859.[1] During the last quarter of the century several attempts appear to have been made to study the marine algæ of the Presidency. Vice-Admiral Pullen had collected seaweeds from the coast of Karachi but J. A. Murray (1881–83) has left a more lasting mark of his own collection by recording some marine plants in his book on the plants of Sind. It is interesting to read a note in the *Journal of the Bombay Natural History Society*, 1887 which says: "Mr. Murray, late Curator of the Kurrachee Museum, exhibited a collection of Marine Algæ consisting of 212 species from the Coast of Sind, and described the same." The same Journal records that Mr. Kirtikar read a paper on Marine Algæ collected by Hon. Justice Birdwood on the Ratnagiri Coast. Kirtikar was a medical man and he has published a brief paper[2] wherein he describes a new species, *Conferva thermalis Birdwoodii* from the hot springs of Vajarabai in Thana District. He has noted three more species, *viz.*, *Ulothrix radicans* Cooke; *Nostoc* sp.; and *Chætomorpha implexa*. It is needless to point out that this information is of only historical importance and would hardly stand the test of science.

In the beginning of the present century (1902–03) an account of some Myxophyceæ collected by Hansgirg in India was published.[3] Hansgirg's collection included about twenty-five species belonging to seventeen genera of the blue-green algæ from the vicinities of Bombay and Poona, majority of which was considered to be new to science. In 1909, Hate published a note on two species of Charophytes, *viz.*, *C. verticulata* and *C. flacida* Br. from the Bombay Island. In 1924 Groves[4] published an important paper on the Charophytes of India wherein he recorded seven species from the Presidency collected by six different people at various times. Two years later, very brief references about the collections of algæ made by Hate (V.N.) and Dixit (D.L.) appeared in the abstracts of papers read at a meeting of the Indian Science Congress. In the same year, Carter published a paper on the Freshwater Algæ from India in which she mentioned two green algæ, *viz.*, *Rhizoclonium hieroglyphicum* Kutz. and *Pithophora radians* W. & G. S. West from Bombay. Thus, upto the close of the first quarter of the present century our knowledge of algæ of this region was next to nil.

In 1927–28 the University of Bombay invited Dr. F. Boergesen of Copenhagen to investigate the marine vegetation of the Presidency. Dr. Boergesen with the help of some teachers and students of the University made large collections of marine algæ from Bombay and Dwaraka. This was indeed the most important landmark in the history of algology in the Presidency. During the last decade or so Boergesen has published a series of papers on his Indian collections.[5,6] Boergesen found a very impressive algal vegetation at Dwaraka and in

one of his earliest papers he has remarked: "Such a veritable littoral algal vegetation within the tropical zone, where everyday the algæ are laid dry for several hours, exposed to the heat of the burning sun and the strong evaporation in this very dry part of India is so far as I know something quite unknown." He has also confirmed that the geographical distribution of some tropical and sub-tropical marine algæ is discontinuous. The marine myxophyceæ have not been touched by him excepting the five species found at Bombay. As a result of his investigations he has added five new genera and thirty-eight new species to science and altogether he has recorded near about two hundred species from the Bombay Presidency alone.

All these years the freshwater algæ made no headway and they had been practically neglected. However, in 1931 the author published a short paper on the Charophytes and this was followed by a series of papers on other freshwater algæ of the Province.[7-10] Twenty species of Charophytes and about seventy-five species of other algæ have been recorded. In 1936 Apte published an account of four species of Volvox from Poona in the *Journal of the University of Bombay*.

Apart from the taxonomic and morphological work mentioned above, practically no work has been done so far on other aspects of algal life. In 1930 the writer[11] determined the percentage of iodine in certain algæ and in 1935 Cooper and Pasha[12] investigated the osmotic pressure and H-ion concentration of seaweeds in relation to those of sea-water.

1 Carter, H. J., *Ann. Mag. Nat. Hist.*, 1859.

2 Kirtikar, K. R., *J. Bom. Nat. Hist. Soc.*, 1886, **1.**

3 Hansgirg, A., *Prag. Citz. Ber. Bohm. Gess. Wiss.*, 1902 & 1903, No. 28.

4 Groves, J., *J. Linn. Soc.*, 1924, **46,** 359.

5 Boergesen, F., *Det. Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser*, 1933, **10.** 8.

6 —, *Ibid.*, 1935, **12,** 2.

7 Dixit, S. C., *J. Ind. Bot. Soc.*, 1940, **18.**

8 —, *Proc. Ind. Acad. Sci.*, 1936, **3.**

9 —, *Ibid.*, 1937, **5.**

10 —, *J. Univ. Bom.* March 1940.

11 —, *J. Ind. Chem. Soc.*, 1930, **7.**

12 —, Cooper, R. E , and Pasha, S. A., *J. Ind. Bot. Soc.*, 1935, **14,** 237.

OBITUARY

SIR ROBERT HADFIELD

THE death of Sir Robert Abbot Hadfield, BT., D.SC., F.R.S., removes the most outstanding figure in the field of Metallurgy. He really belonged to the latter half of the last century, having become world-famous by the discovery of his Manganese Steel in 1888. The importance of manganese in the making of steel was first realised by Sir Henry Bessemer, but it was not until the systematic researches of Sir Hadfield on the alloys of iron and manganese culminated in the discovery of the famous Manganese Steel, that the further development of alloy steels became possible. Quite apart from the wonderful properties of the newly discovered alloy, the method of Sir Robert Hadfield's researches attracted wide attention from all the leading metallurgists of the day. It may not be out of place to refer here to the tribute paid to him in 1903 by Prof. Osmond, one of the great leaders in the development of modern metallurgical thought:

"The series of the Hadfield alloys had been prepared with a degree of technical skill which upset many falsely conceived ideas, resulting from imperfect preparation or from faulty manipulation. Hadfield's method was a truly scientific one, by means of which all the independent variables which could be disposed of were eliminated. With the materials for investigation thus prepared, which for a long time had been unrivalled, the results obtained were at once clear, coherent and definite. Moreover, Hadfield had not only made the best personal use of this wealth of material but with never-failing generosity, of which the writer had many times availed himself, he had placed it at the disposal of those inventors who were desirous of subjecting it to their methods and using it for their researches. Consequently the useful results had gone on increasing and from the accumulations of these the general laws had been evolved,

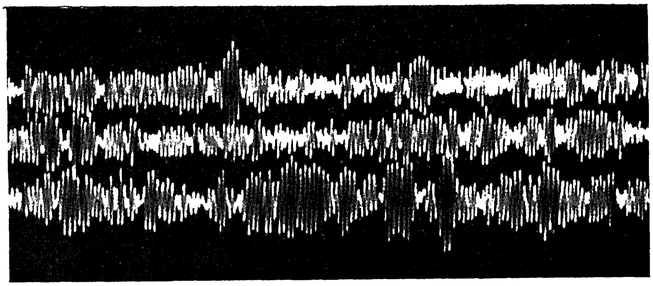
which formed the main object of all research."

That Sir Robert was not only the inventor of Manganese Steel, but also the pioneer in the field of other alloy steels is not generally known. It is claimed by some that he was a true prophet in regard to the ever-increasing importance of these special steels. In his paper on "Alloys of Iron and Chromium" presented to the British Iron and Steel Institute in 1892, he said, "The author cannot but think that the special question of steel alloys or combinations will be eventually found to possess considerable practical importance to the world at large and perhaps be the means of eventually enabling our Civil and Mechanical Engineers to design and carry out works of great magnitude". How true this forecast is, made thirty years ago, will easily be realised by the modern technicians.

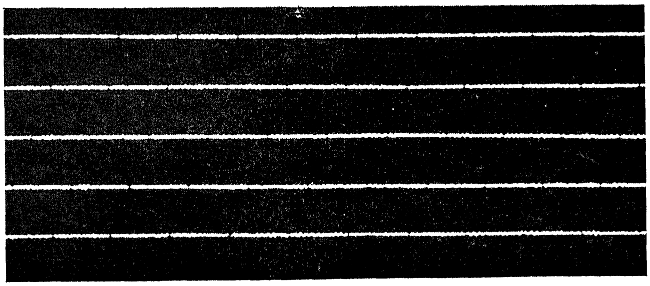
Sir Robert Hadfield was Chairman of the firm Hadfields Ltd., Sheffield, and director of a number of other companies. He was connected with a number of technical societies and was President of British Iron and Steel Institute from 1905–07. He was awarded in 1904 the Bessemer Gold Medal. In 1908 he was knighted and the following year became F.R.S. He has contributed a number of valuable papers to the Iron and Steel Institute and other technical Institutions.

THE SEVERE CYCLONIC STORM OF 16th OCTOBER 1940

A DEEP depression off the Konkan-Kanara coast developed into a severe cyclonic storm which moved towards Bombay at 2 a.m. (I.S.T.) on the 16th October 1940, and about six hours later crossed the coast near Bombay causing considerable damage in and round the City.



Microseisms at the time of the Cyclonic Storm on 16–10–40



Microseisms on the day previous to the Storm

The barometer at the Colaba Observatory showed a fall of 0·27 inches between 10–30 p.m. on the 15th and 8 a.m. on the 16th. The minimum reading of the barometric pressure was 29·42 inches as read from the microbarograph. This occurred at 7–45 a.m. on the 16th at which instant a single gust of wind reached a hurricane force of 75 miles per hour, and the wind force remained very high from about 7–30 a.m. till about 8–30 a.m. during which the average windspeed was as high as about 60 miles per hour. Both these values are so far the highest on record at the Colaba Observatory.

The Milne-Shaw seismograph recorded the strongest microseisms ever recorded by the instruments here till now. Portions of this record as also that of the day previous are reproduced here for comparison.

The microbarograph shows very rapid fluctuations of the pressure between 5–45 a.m. and 10–45 a.m. on the 16th. The storm abated at about 12–30 p.m. on the 16th.

M. R. RANGASWAMI.

Colaba Observatory,
Bombay,

October 17, 1940.

LETTERS TO THE EDITOR

On Poincaré's Theorem in Stellar Dynamics

THE major problems of stellar dynamics are concerned with systems of discrete gravitating particles which are virtually free from an external field of force. Poincaré's theorem[1] for such systems is usually expressed in the form

$$\frac{d^2}{dt^2}\Sigma m\rho^2 = 4T + 2V = 4h - 2V, \qquad (1)$$

where m is a typical mass of the system, ρ its distance from the origin, and T and V are the total kinetic and potential energies h being their sum. Without any loss of generality the centre of mass of the system may be supposed to be permanently at rest at the origin. From (1) it follows that when the steady state is reached

$$2T + V = 0 \qquad (2)$$

and $\quad T = -h, \quad V = 2h. \qquad (3)$

The simplifying hypothesis of a steady state does not always fit in with facts and it is therefore worthwhile looking into possible rates of condensation and disintegration for such systems. These considerations also help us to determine the age of a system.

Let us consider the parameters S, R defined by

$$S = \Sigma m\rho^2 - 2ht^2 = MR^2 - 2ht^2, \qquad (4)$$

where M is the total mass of the system. (1) is now equivalent to

$$\ddot{S} = -2V \qquad (5)$$

Hence $\quad \ddot{S} \geqslant 0 \qquad (6)$

Also $\quad \dot{S} = 2(\Sigma m\rho\dot{\rho} - 2ht) \qquad (7)$

We have

$$\frac{\dot{S}^2}{4} = S[\Sigma m\dot{\rho}^2 - 2h] + 2h\Sigma m(\rho - \dot{\rho}t)^2 - \sum_m\sum_{m'} mm'(\rho\dot{\rho}' - \rho'\dot{\rho}) \qquad (8)$$

Now $\quad \Sigma m\dot{\rho}^2 - 2h = -2V \geqslant 2T' \qquad (9)$

where T′ is the kinetic energy of rotation. If the resultant angular momentum is α it can be easily shown[2] that

$$T' \geqslant \alpha^2/(S + 2ht^2). \qquad (10)$$

We may therefore write

$$T' = \alpha^2 z/(S + 2ht)^2 \qquad (11)$$

where $\quad Z \geqslant 1 \qquad (12)$

Thus

$$\frac{\dot{S}^2}{4} = S\left[-2V - \frac{2\alpha^2 z}{S + 2ht^2}\right]$$

$$+ 2h\Sigma m\,(\rho - \dot{\rho}t)^2 - \Sigma\Sigma mm'\,(\dot{\rho}\rho' - \rho'\dot{\rho})^2. \quad (13)$$

Using (5), the last equation can be restated as

$$S\ddot{S} - \frac{\dot{S}^2}{4} - 2\alpha^2 z\,\frac{S}{S + 2ht^2} =$$

$$\Sigma\Sigma mm'\,(\rho\dot{\rho}' - \rho'\dot{\rho})^2 - 2h\Sigma m\,(\rho - \dot{\rho}t)^2. \quad (14)$$

It is obvious that for particles satisfying the equation of Milne's law of recession,[3] *viz.*,

$$\dot{\rho} = \rho/t, \quad \dot{\rho}' = \rho'/t, \text{ etc.} \quad (15)$$

the right-hand side of (14) vanishes. But (15) cannot be rigorously true for a classical system of gravitating particles as (14) clearly shows.

It is possible to discuss to some extent the evolution of a stellar cluster with the use of the parameter S. For if $\dot{S}$ is non-negative when $t = 0$, S is always positive and increasing by virtue of (6). In case $\dot{S}$ is negative initially S may attain a minimum or decrease indefinitely. The system is hyperbolic, elliptic or parabolic in character according as h is positive, negative or zero respectively. For an elliptic or parabolic system S will always be positive and if $\dot{S}$ is initially negative so that the system is shrinking ($\dot{R} < 0$) in its early stages S attains a minimum before proceeding to increase indefinitely. For a hyperbolic system S always increases or decreases or the first phase of decrease is followed by the second of uninterrupted increase.

These simple characteristics of the behaviour of S can be utilized in inferring the past and predicting the future of stellar clusters. R may very conveniently be taken as a measure of dispersion since the variation in the masses of stars is generally small. For an expanding hyperbolic cluster let $R = R_0$ at $t = 0$ and $R = R_1$ at $t = t_1$. Then

$$R_1^2 - \frac{h}{M}\,t_1^2 > R_0^2.$$

Hence $$\left\{\frac{(R_1^2 - R_0^2)M}{h}\right\}^{\frac{1}{2}} > t_1 \quad (16)$$

Similarly a lower limit on time can be determined for condensing systems for which h is negative.

Stellar considerations apart, the statement of Poincaré's theorem in the form (5) with the immediate conclusion (6) and the equation (14) are believed to be two new results sufficiently important in their own rights.

V. V. Narlikar.

Department of Mathematics,
Benares Hindu University,
October 7, 1940.

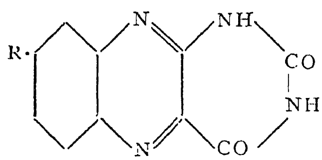
1 Smart, W. M., *Stellar Dynamics*, 1938, 310.
2 Birkhoff, G. D., *Dynamical System*, 1927, 266.
3 Narlikar, V. V., *Nature*, 1935, **149**, 135.

Further Synthesis of N[1]-Substituted Heterocyclic Derivatives of Sulphanilamide

It has been pointed out previously[1] that compounds more polyvalent in therapeutic action than sulphanilamide should be looked for amongst its derivatives wherein the amino group is free and the sulphonamide radical carries a suitable heterocyclic substituent. In the choice of the heterocyclic rings for the synthesis of such a class of compounds, we were mainly guided by the ring systems present in the reputed antiseptics, chemotherapeuticals of established value in the protozoal infections and, of recently, the products with vital biochemical functions, *e.g.*, the vitamins, co-enzymes, nucleic acids, etc. Working with this programme, in addition to those reported previously,[1] some more sulphanilamido derivatives of the typical ring systems have been synthesised to serve as model compounds for future search.

7-Aminoalloxazine,[2] uramil (obtained by reducing violuric acid with sodium bisulphite) and 4-aminouracil[3] have been converted into the corresponding sulphanilamido derivatives of formula (I), (II) and (III) by condensing with p-acetaminobenzene sulphochloride and hydrolysing the products obtained in the usual ways,[1]

Similarly, 2-sulphanilamido-pyrimidine (IV, R′ = R″ = H), the corresponding 4-methyl (IV, R′ = Me, R″ = H) and 4 : 6-dimethyl derivatives have been synthesised by three different methods. Adenine and 4 : 5-diaminouracil have also yielded the sulphanilamido derivatives with one molecule of the sulphochloride); but in these cases, a decision between the two possible structures has not been made.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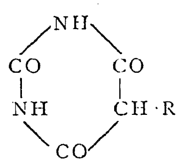
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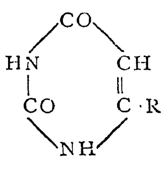
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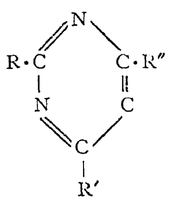
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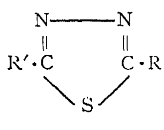
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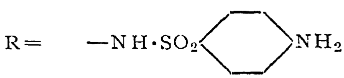

2-Amino 1 : 3 : 4-thiodiazole and 2-amino-5-methyl 1 : 3 : 4-thiodiazole have similarly yielded 2-N[1]-sulphanilamido-1 : 3 : 4-thiodiazole (m.p. 216–18°) (IV, R = H) and 2-N[1]-sulphanilamido-5-methyl thiodiazole (m.p. 180–82°) (IV, R = CH_3) respectively.

Similar derivatives of the above and related structures are being synthesised.

Full details will shortly be published.

These compounds are being tested in the usual experimental bacterial infections.

K. GANAPATHI.

Haffkine Institute,
Parel, Bombay,
October 1, 1940.

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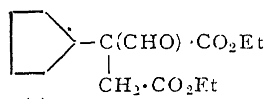
[1] Ganapathi, K., *Proc. Ind. Acad. Sci.*, 1940, **11**, 298; **12**, 274; *Ind. Jour. Med. Res.*, 1940, **27**, 971; *Curr. Sci.*, 1940, **9**, 314.

[2] *J. Ind. Chem. Soc.*, 1938, **15**, 77.

[3] *Ibid.*, 1937, **14**, 627.

Lactones Related in Structure to Cardiac Aglucones: The Lactone of β-*Cyclo*pentyl β-Aldehydo-Propionic Acid

As early as 1937, work was started by the author with a view to synthesising lactones related in structure to cardiac aglucones.[1a] In a detailed communication published last year,[1b] a standard method was described for the synthesis of β-ring substituted succinic acids as an essential groundwork for the larger plan of synthesis of the lactones. A scheme for the synthesis of the lactones was given, and applying the scheme to the case of α-*cyclo*pentyl succinic acid (I), and its successful if peculiarly difficult, conversion to β-*cyclo*pentyl-β-aldehydopropionic acid (II) were described. The accumulation of large amounts of (II) to convert it into (III)[2] a β-substituted βγ-unsaturated-γ-lactone of the type found in cardiac aglucones—was being delayed but was, however, pursued. In a very recent communication[3] Elderfield and his collaborators have,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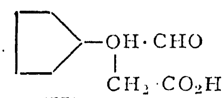
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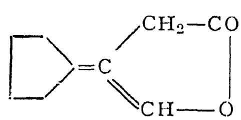
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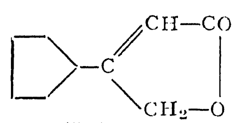
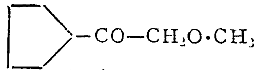

(IV)

without giving experimental details, outlined a different method of synthesis of such lactones. In their scheme, lactones of type (III) are obtained through the isomeric αβ-unsaturated lactones of the type (IV). We have sought to apply this new scheme in the case of the synthesis of (III) and (II). We have succeeded in obtaining them, and hence there can be no doubt about the validity of the various structures in either of the two schemes.

Methoxy acetonitrile (V)[4] was condensed with the Grignard reagent from *cyclo*pentyl bromide to yield the ketone (VI), b.p. 192–194°/680 mm. (2 : 4-dinitrophenyl hydrazone, m.p. 130°). The ketone on treatment with zinc and ethyl bromoacetate furnished in excellent

yield the hydroxy ester (VIII), b.p. 140°/6 mm. Simultaneous dehydration, demethylation and

CN
$|$
CH_2OCH_3
(V)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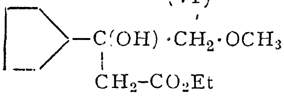
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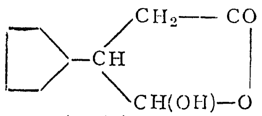
(VIII)

lactonisation of (VII) was effected by HBr in acetic acid. Distillation of the product so obtained yielded in the place of the expected $\alpha\beta$-unsaturated lactone[2] (IV), the requisite $\beta\gamma$-unsaturated-γ-lactone (III),[5] b.p. 155°/5 mm. The proof for the structure (III) would seem to lie in the fact of its immediate response to the very characteristic Legal's test,[6] its slow reduction of the Tollen's reagent,[5] and its rather high b.p. This point is, however, kept open. On treatment with absolute methyl alcoholic potash (3%), (III) furnished the hydroxylactone, presumably (VIII), tautomeric with the aldehydo acid (II). The semicarbazone of this newly prepared aldehydo acid melted at 196° and under identical conditions of heating* the semicarbazone previously described by the author[1b] melted at 196°, and the mixed m.p. of the two specimens was not depressed.

The lactone (III) is almost insoluble in water and is not affected appreciably by prolonged boiling with water. Further work is being carried on in the direction of incorporating features in (III) which would make it water-soluble.

S. K. RANGANATHAN.

Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
July 27, 1940.

[1a] Ranganathan, *Curr. Sci.*, 1937, **6**, 277.
[1b] —, *J. Ind. Chem. Soc.*, 1939, **16**, 107.
[2] Windaus, *Wiss. Math. Phy. Kl. Gottingen*, 1935, **70**, 35.
[3] Fried, Rubin, Paist and Elderfield, *Science*, 1940, **91**, 435.
[4] Henze and Rigler, *J. Amer. Chem. Soc.*, 1934, **56**, 1350.
[5] *Cf.* Wolff, *Annalen*, 1885, **229**, 250, 254.
[6] Jacobs, Hoffmann and Gustus, *J. Biol. Chem.*, 1926, **70**, 1.
* The melting point varies with the rate of heating.

Soap Gels in Pinene

PRASAD AND MATHUR[1] found that sodium oleate dissolves in pinene at 140° and the clear solution sets, on cooling, to a transparent gel. It has been found by the authors that potassium oleate, sodium palmitate and sodium stearate also dissolve in pinene when heated to 140°, and a clear solution thus formed sets, on cooling, to a transparent gel. The time of setting of these gels has been determined by Fleming's method and has been found to decrease with (i) an increase in the amount of soap in the gel and (ii) a decrease in the temperature at which the solution is allowed to cool.

All these gels exhibit the phenomenon of syneresis but the rate of syneresis of different gels is different. It is maximum in the gels of sodium oleate and least in those of sodium palmitate.

A systematic study of the several properties of these gels has been started in this laboratory and some of the results obtained are being communicated for publication elsewhere.

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Chemical Laboratories,
Royal Institute of Science,
Bombay,
September 30, 1940.

[1] Prasad and Mathur, *Curr. Sci.*, 1940, **9**, 119.

Iwanoffia terrestris (Iwan.) Pascher from Fyzabad

THIS terrestrial member of the order Chætophorales was originally described by Iwanoff from Russia in 1899 as *Stigeoclonium terrestre.* It was found growing on moist earth. On account of the presence of biciliate macro- and micro-zoospores, Pascher described it as a new

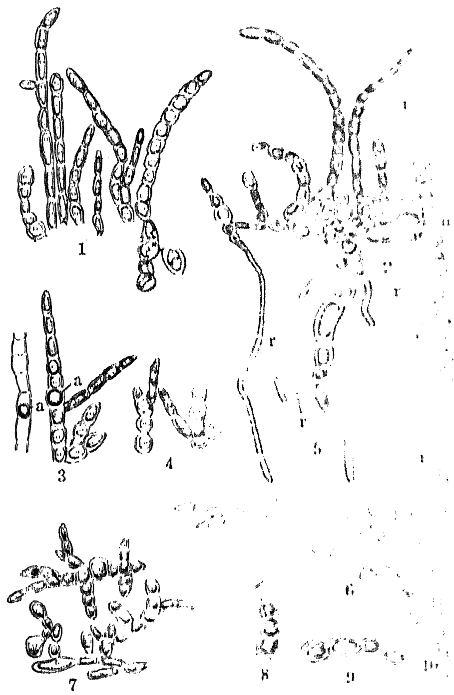
genus named as *Iwanoffia* in 1905. *Iwanoffia* differs from *Stigeoclonium* in its terrestrial habitat and the presence of biciliate macro- and micro-zoospores, which are quadriciliate in *Stigeoclonium* which is a purely aquatic genus.

So far *Iwanoffia* has not been recorded from India. This alga which resembles Iwanoff's alga in many features was originally collected by the present author in January 1939 growing on moist bricks of the arch of a masonry bridge over a small dried ravine near Bharat Kund in Fyzabad district. It formed a yellowish-green encrustation on the bricks resembling the coating of *Pleurococcus* on pitchers and moist wood-work during the monsoons. Only the lowermost tiers of bricks which were in contact with the moist clay of the ravine had the covering of this alga. Mostly it was found in the form of a pure growth, and only in a few patches the protonema of a moss was found mixed with it. Later on it was also collected in the dry months of April, May and June, when it appeared in the form of a yellowish-brown powdery covering.

The plant body in this alga is differentiated into three well-marked regions, which may be described as projecting, prostrate, and rhizoidal systems. In this respect this alga resembles *Fritschiella tuberosa* Iyengar as the general scheme of organization of the thallus is the same in both. However, in detail differences are numerous, and when closely examined this alga is readily distinguishable from *Fritschiella*.

Projecting System.—Filaments of the projecting system are usually unbranched and curved in a bow-like manner (Figs. 1 and 2). However when branching occurs, it is very sparse, and it is rare to find branches of a second or third degree (Figs. 4 and 5). In this respect this alga differs markedly from *Fritschiella* with its characteristic richly-branched fanlike projecting system. Terminal cells have blunt apices. Each cell contains a single ulotrichaceous chloroplast, each bearing a solitary pyrenoid. Chloroplasts are deep green in colour in specimens collected from moist bricks, while they are slightly bluish-green in samples scraped from dry bricks. Cells of the projecting system are 5–9 μ broad and 9–27 μ long and are cylindrical to barrel-shaped in appearance. Filaments of the projecting system are rather loosely connected with the cells of the prostrate system and easily get detached.

Prostrate System.—Cells of the prostrate system, which are highly developed in this alga, form a dense mat-like parenchymatous structure closely encrusting brick-particles (Fig. 2). Cells of this system are usually more or less



Figs. 1–10. *Iwanoffia terrestris* (Iwan.) Pa[illegible].

Fig. 1.—Filaments of the projecting system; Fig. 2.—A plant showing projecting filaments (i), parenchymatous cells of the prostrate system (ii), and rhizoids [illegible]; Fig. 3.—Aplanospores (*a*); Fig. 4. Branching in filaments of the projecting system; Fig. 5.—A [illegible] plant showing rhizoids (*r*); Fig. 6.—A part of a plant showing prostrate and projecting systems. The cells of the prostrate system are dotted; Fig. 7. Cells of the prostrate system; Fig. 8.—An empty cell from which a zoospore had escaped; Fig. 9. Akinetes; Fig. 10. A rhizoid.

All figs. are × 220, excepting 5 and 10 which are × 245.

rounded. They are on the average 7–14 μ in diameter. Very probably the cells of the prostrate system serve the function of perennation, and in the samples collected in the dry

month of June, it was found that these cells had developed into akinetes with thick stratified walls and contents of a homogeneous nature (Fig. 9).

Rhizoids.—Rhizoids usually arise from the cells of the prostrate system (Figs. 2 and 5). In some cases it was found that the lower cells of the projecting system were directly prolonged into long rhizoidal cells (Fig. 10). In some cases the rhizoids are 1–2 celled, while in others, they are fairly long many-celled structures. Rhizoids are so closely attached to brick-particles, that it is very difficult to detach them. When first examined they escaped notice, as they get mutilated when the alga is scraped. Upper cells of the rhizoids usually contain fragments of chloroplasts, while lower cells are usually hyaline.

Some of the cells of the projecting system were found empty, and an apical cell was found ruptured (Fig. 8), possibly due to the escape of zoospores. However no zoospores were actually observed by the author.

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In its structural organization *Iwanoffia* stands midway between *Stigeoclonium* and *Fritschiella*, and marks an important stage in the conquest of land by algal pioneers.

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2, Park Road,
Allahabad,
September 18, 1940.

Occurrence of *Sclerospora graminicola* (Sacc.) Schroet. on *Setaria verticillata* Beauv. in Allahabad

AMONG the downy mildews *Sclerospora graminicola* (Sacc.) Schroet. is well known in India as the cause of the green ear disease of bajra (*Pennisetum typhoideum*) which, according to Mitter and Tandon[1] may damage up to 45 per cent. of the plants in low-lying fields in Allahabad. Butler and Bisby[2] record this parasite on only one other host, *viz.*, *Setaria italica*, besides bajra. We have observed this fungus growing on *Setaria verticillata* Beauv. in a shady plot in the University Botanical Gardens and we believe it has not been recorded before on this host in India. So far only the conidial stage has been found. Amongst the plants growing in the garden most of the leaves are attacked. The infected areas soon turn brown and wither. A detailed description of the parasite on this host will shortly follow.

J. H. MITTER.
A. K. MITRA.

Department of Botany,
University of Allahabad,
September 7, 1940.

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[1] Mitter, J. H., and Tandon, R. N., *Journ. Ind. Bot. Soc.*, **9**, 243.
[2] Butler and Bisby, *The Fungi of India*, 1931, p. 7.

Note on Sorghum Stapfii. C.E.C. Fischer

Sorghum Stapfii. C. E. C. Fischer is a wild grass native to India. Hooker[1] described it as *Andropogon Stapfii.* Index Kewenisis Supplt. II (1886–1900) gives this plant the status of an independent species. Gamble[2] classified it under the genus *Sorghum.* This plant has not been mentioned by Snowden[3] in his "Cultivated Races of Sorghum".

The chromosome number of this plant as counted in meiosis is $n = 10$. The meiosis is regular. The chromosomes are rather small.

It is interesting to note that *S. Stapfii* easily hybridizes with *S. sudanense* Stapf. and in the progeny of the hybrid segregations occur for both types of plants. *S. sudanense* as also *S. arundinaceum* Stapf., *S. verticelliflorum* Stapf. and *S. œthiopicum* (Hack) Ruper. ex Stapf. are considered by Snowden (*l. c.*) to be primarily concerned in the evolution of the cultivated sorghums. *S. sudanense* hybridises easily with cultivated sorghum [*S. dochna* Forsk. Snowden and also with *S. virgatum* Stapf. Snowden (*l. c.*)] *S. Stapfii* thus forms yet another wild sorghum with which *S. sudanense* hybridizes easily,

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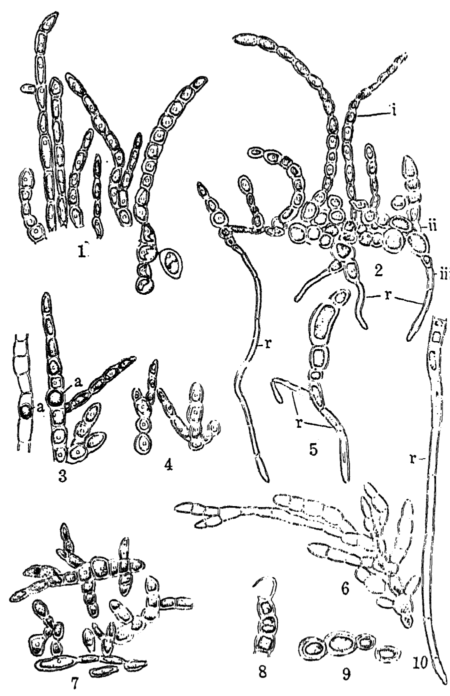

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J. H. MITTER.
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Department of Botany,
University of Allahabad,
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1 Mitter, J. H., and Tandon, R. N., *Journ. Ind. Bot. Soc.*, **9**, 243.
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It seems reasonable therefore that *S. Stapfii* should find a place in the series *Spontanea* of the Sub-Section *Arundinacea*, of Snowden.

N. KRISHNASWAMY.
G. N. RANGASWAMI AYYANGAR.
Agricultural Research Institute,
Coimbatore,
September 17, 1940.

[1] Hooker, J. D., *Flora of British India*, 1897, **7**, 184.
[2] Gamble, J. S., *Flora of Madras*, 1934, **10**, 1735.
[3] Snowden, J. D., *The Cultivated Races of Sorghum*, 1936.

On the Natural History of *Rastrelliger kanagurta* (Russell) with Special Reference to its Spawning Season and Eggs.*

THE first description of the South Indian mackerel was by Russel in his *Fishes of Vizagapatam*[1] published in 1803. As his name '*Kanagurta*' was an adaptation from the vernacular, many of the subsequent authors adopted Rupell's specific name 'microlepidotus'. Jordon and Dickerson[2] in 1908 distinguished the chub-mackerel *Rastrelliger* with its deeper body, larger scales, feebler dentition and feathery gill-rakers from the typical mackerel and established the genus *Rastrelliger* for it. As the South Indian mackerel presents these characters, it should be included in the genus *Rastrelliger*. As Russell's names have now been generally accepted, we have called the common South Indian mackerel *Scomber microlepidotus* of Day, *Rastrelliger kanagurta* (Russell).

According to H. W. Fowler[3] this species is widely distributed in the Indo-Pacific region. On the West Coast of the Madras Presidency the seasonal fishery of this fish is of great economic value, and ranks next only to that of *Sardinella longiceps*, the Indian oil-sardine. The statistics collected by the Madras Fisheries Department show that, in a good season like that of 1928–29, as much as about 21 lakhs of maunds (= 75,267 tons) of this fish valued approximately at 27 lakhs of rupees is taken on the coasts of the Malabar and South Kanara Districts (250 miles). The fishery usually commence in August and continues to the end of May; it reaches its peak in October, November and December. As the mackerel taints quickly, the quantity consumed in the fresh condition is not considerable; the great bulk of the catches is cured and the product exported to the interior districts in India and to Ceylon and Singapore. The fishery is subject to great fluctuations as the mackerel fisheries elsewhere in the world. In some years the abundance of the mackerel seems to coincide with the scarcity of the oil-sardine and *vice versa*. As both are plankton-feeders, it is obvious that they both compete for food in a mutual struggle for existence and otherwise affect each other's welfare in a manner not yet intelligible. Over 5,000 specimens have been examined from 1934.

Size: Specimens of this mackerel less than 10 cm. in length have not been met with in the catches examined. 25 cm. is the maximum length to which this fish grows on the west coast as recorded by Day.[4] The fish attain maturity at about a length of 19 cm. The size forming the bulk of the commercial catches varies from 20 cm. to 23 cm.

Food: The diet of this mackerel consists entirely of plankton. The following organisms have been found in its stomach contents.

Zooplankton: (1) Copepods chiefly *Paracalanus* sp., *Euterpina* sp., *Acartia* sp., and *Oithona* sp.; (2) Larval bivalves; (3) Evadne; and (4) Larval prawns.

Phytoplankton: (1) *Conscinodiscus* chiefly *C. jonesianus*, *C. oculosiridis*, *C. gigas* var. *dioramma*, and *C. joneschii*; (2) *Peridinians* *P. depressum* and *P. ovatum*; (3) *Fragilaria*; (4) *Ceratium*—*C. tripos* and *C. massiliense*; (5) *Thalassiothrix nitzschioides*; (6) *Nitzschia* sp.; (7) *Asterionella japonica*; (8) *Rhizosolenia*; (9) *Pleurosigma*; (10) *Dinophysis homunculus*; (11) *Biddulphia* sp; (12) *Planktoniella*; (13) *Ceratulina*; and (14) *Tintinnus*.

Its European relative, *Scomber scombrus* is said to include in its dietary small sprats and pilchards.[5] Till now no vertebrate material has

* Published with the kind permission of the Director of Industries and Commerce, Madras,

been seen in the stomach-contents of the Indian mackerel. Usually copepods preponderate showing that this is its favourite item of food.

Spawning Season: Recovering spents are usually met with in September when gonads begin to refill and grow. The maturation of the testis proceeds more rapidly and is much in advance of that of the ovary. Simultaneously with the progress in size of the gonads a corresponding decrease in the catches is noticed, and by the end of May the catches dwindle. As the spawning of this fish synchronizes with the outbreak of the South-West Monsoon and as fishermen don't venture out to sea to fish during the monsoon, any research work on the spawning of the mackerel is bound to be extremely difficult without a sea-going research vessel. The data collected relate to catches which are made occasionally during the breaks in the monsoon. Recovering spents and maturing individuals are abundant enough from September onwards but when they are in a condition preparatory to spawning in May, the mackerel becomes scarce and ultimately disappears under cover of the South-West Monsoon eluding all attempts at research on their eggs and early stages. It is possible that they recede from coastal waters which during this period is much disturbed by the rough winds and rain caused by the onset of the South-West Monsoon. This is favourable to the propagation of the species as ripe individuals which escape the nets go beyond the fishing zone of the fishermen and thereby get a good chance to spawn unmolested by man. Fish in spawning condition are therefore difficult to secure. Besides they appear to spawn at night; but as no spent-fish are found in the day-catches it may be inferred that mackerel either do not spawn in inshore waters exploited by the local fishermen or after spawning at night, they retire beyond their reach. The appearance of spent ones in occasional catches made in August 1937, indicates that the fish after spawning do not permanently retire to the deep sea but seek coastal waters and that their spawning grounds are not very far from the coast.

The above observations roughly show that the spawning of mackerel begins sometime about June and continues till about the end of September, rather a long period.

Eggs: According to Delsman[6] the diameter of the eggs of *Rastrelliger kanagurta* varies from 0·85 mm. to 0·95 mm. The diameter of the preserved eggs measured by us varies from 0·54 mm. to 0·70 mm. It is presumed that Delsman measured fresh eggs. The plankton containing the egg is usually preserved in the boat in 5 per cent. sea-water formalin as otherwise the eggs will disintegrate on the return journey of 4 to 5 miles in an open boat under a tropical sky. Delsman had a power-boat fitted with a laboratory and he studied the eggs very often at the spot where they were collected. The somewhat smaller diameter of the eggs noticed by us, in all probability is due to the eggs having shrunk in preservation. The average number of eggs in the South Indian mackerel is nearly 94,000. On one occasion on 1st June 1937, mature and transparent eggs were obtained from fully ripe individuals and artificial hatching was tried but did not meet with success. Delsman remarks as follows:

"A characteristic feature of the '*Kembung*'† eggs is that they are fairly difficult to hatch. When isolated in a glass with clear sea-water a good many of them die in the course of the day and sink to the bottom, becoming opaque. As a rule only a few hatch. This occurs in the course of the evening between 4 and 6 p.m."

In a haul of shore plankton taken at a distance of 5 miles from the shore off Calicut (Chaliyam) on 5th June 1937, at a spot where mackerel were being caught, there were mackerel eggs of the sizes and characteristics of those obtained on 1st June 1937 from full mature specimens. 405 eggs were collected in different stages of development beginning with eggs just fertilized and ending with those with larvæ ready to hatch out. There were also just hatched larvæ. The eggs which were undoubtedly mackerel eggs occurred in a spot where ripe mackerel shoaled and as the fertilised eggs closely resembled in size and

† *Kembung lelaki* is the local vernacular name given by Delsman for *Rastrelliger kanagurta*.

character those obtained from a spawning mackerel, it seems certain that the eggs in the plankton were those of the mackerel. Dr. Delsman also identified mackerel eggs in the plankton in the Malay Archipelago by a process of elimination and inference. In the absence of artificially fertilized eggs, the inference lacks that conclusiveness which was obtained for the eggs of the oil-sardine in 1934 (*vide* paragraph 11 of Administration Report of Department of Fisheries for the year 1934–35). This conclusive proof can only be furnished when spawning fish are secured and artificial fertilization is carried out.

Internal Parasites: These are found in the pyloric coecæ, the gut and in the peritonium covering the gut. The parasites in the pyloric coecæ and the gut are numerous and appear to be free scolices of tapeworms or metacestodes. Those found imbedded in the peritonial tissue or sometimes free in the body-cavity are just a few not exceeding two or three in one specimen and are fully developed milk-white tapeworms.

The presence of free scolices in the mackerel indicates that it is the intermediate host of an adult tapeworm or tapeworms and therefore forms the food of predaceous animals such as sharks, perpoises, etc., among whom one should expect the permanent host, whereas the presence of a fully developed tapeworm shows that the scolices must have found their way into the body through the food of the mackerel. In the former case or perhaps in both cases, one might trace possible causes for the natural fluctuations of this mackerel.

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V. John.

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[1] Russell, *Fishes of Vizagapatam*, 1803, **2**, 28, pl. 136.
[2] Jordon and Dickerson, *Proc. United States National Museum*, 1908, **34**, 607.
[3] Fowler, H. W., *The Fishes of Oceania*, 1928, p. 132.
[4] Day, *The Fauna of British India: Fishes*, 1889, **2**.
[5] Cunningham, J. T., *The Natural History of the Marketable Marine Fishes of the British Islands*, 1896.
[6] Delsman, H. C., *Treubua*, 1926, **8**, 395.

The Apodan Sperm

The Sperms of Amphibia are of two types. The anuran type is very different from the urodelan type and is, curiously, the simpler. In the former, the head is followed by a short but conspicuous neck region in which, in the majority of forms, both the centrioles are lodged. A portion of the base of the flagellum is ensheathed by the mitochondria which are disposed in a spiral manner. This region is usually called the "middle piece" (Wilson, 1928). The structure of the urodele sperm, on the other hand, is highly complex and is very different from that of the Anura. Of the two centrioles, the proximal or head centriole becomes greatly enlarged and conspicuous as a rounded, ovoid or elongated body closely applied to the head of the sperm. Gatenby (1931) finds a clear non-staining space between the head and the proximal centriole in the sperm of *Desmognathus fusca*. The distal centriole, on the other hand, undergoes a curious modification. It becomes converted into a ring which greatly elongates and often extends backwards in the form of a long pessary through a considerable distance along the tail.

Nothing is known of the spermatozoa of the third group of Amphibia, the Apoda. The Sarasins (1890) figured the sperms of *Ichthyophis glutinosus* but their observations are by no means complete and in a review of the subject of the structure and development of the animal sperm, Ballowitz (1913) denies all knowledge of the sperms of Apoda.

In the course of my studies on the spermatogenesis of Apoda, I have had opportunities of examining the sperms of *Ichthyophis, Uræotyphlus* and also *Siphonops* which I describe below.

Figs. 1, 2 and 3 show the ripe sperms of *Ichthyophis glutinosus, Uræotyphlus narayani* and *Siphonops annulatus*. They have been drawn at the same magnification. A variation in the size of the head is noticeable in the three species. The acrosome is spatulate and

though slightly variable in size in the three species, is of similar appearance.

But it is the post-nuclear region that is of great interest. In this respect the apodan

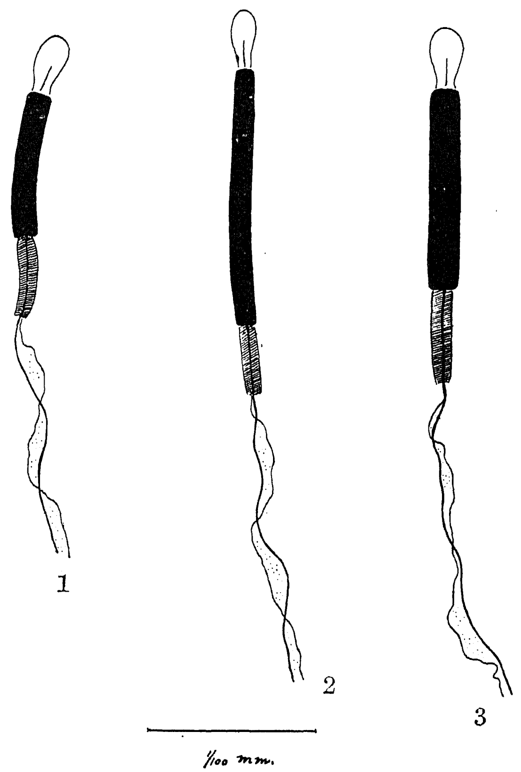

Fig. 1.— The sperm of *Ichthyophis glutinosus*. Fig. 2. —The sperm of *Uraeotyphlus narayani*. Fig. 3.—The sperm of *Siphonops annulatus*.

sperm resembles that of the Anura. Both the centrioles are found close behind the nucleus. The proximal centriole becomes flattened and is closely applied to the nucleus. Very often it is so deeply stained that it is indistinguishable from the nucleus. But in Flemming and other chrome-osmium fixatives its presence is clearly revealed and a non-staining area separates the two. The distal centriole, after giving off the axial filament also travels anteriorly and fuses with the base of the nucleus. There are no indications of the elongation of either of the centrioles to form the compact deeply staining body (proximal centriole) or the greatly produced ring (distal centriole) of the urodele sperm. In respect of the disposition of the centrioles, therefore, there is a close similarity between the apodan and anuran sperms.

In regard to the disposition of the mitochondria also there appears to be a striking resemblance. It is known that in Anura, the mitochondria occur at the base of the flagellum, occupying a longer or shorter region in the form of a spiral sheath. The question of the presence of mitochondria in the urodele sperm is still unsettled but the recent work of Gatenby (1931) would appear to show that while mitochondria may occur scattered here and there around the nucleus, their aggregation to form a distinct post-nuclear region is not seen. In the apodan sperm there is a distinct sheath of mitochondria around the base of the flagellum recalling the condition found in Anura. All the three species exhibit it (see Figs.). But the mitochondria do not show the spiral disposition described in Anura.

In all the three species, the tail is provided with an undulating membrane which is continued along the greater part of its length.

I am thankful to Prof. A. Subba Rau for placing two magnificent specimens of *Siphonops annulatus* at my disposal.

B. R. Seshachar.

Department of Zoology,
Central College,
Bangalore,
October 15, 1940.

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Mixed Cropping and the Cotton Root Rot Disease (*Macrophomina phaseoli* and *R. Solani*)

The growing of cotton mixed with another crop has been practised for long in India and other tropical countries. In the Punjab, a leguminous or other crop is often sown with cotton for use as fodder. Recently the investigation of benefits of mixed cropping has been taken up in some stations; it is in progress at Rothamsted. But the effect of mixed cropping on the incidence of diseases has not been fully studied. Some experiments have been conducted on this subject at Lyallpur in relation to the root rot disease of cotton.

The experiments were conducted in a field which was heavily and uniformly infected with the disease. Mollisoni 39—an indigenous cotton—was sown in May, at the optimum time for the appearance of the disease, with a view to provide conditions favourable for a vigorous attack of the disease. Sorghum J. 20 was broadcasted on the same day in between the rows of cotton. A border of 2 feet was also sown with sorghum all round the cotton crop. Another set of plots was sown with pure cotton to serve as controls. The plots were arranged in randomised blocks replicated four times. Weekly counts of mortality due to root-rot were made both in the mixed and pure cotton plots. Records of air temperature, soil temperature (at 30 cm. depth) and humidity were taken twice a day, *i.e.*, at 8 a.m. and 5 p.m. The sorghum crop was removed on the 16th of August.

The figures for the average per cent. mortality from week to week in the mixed and pure cotton plots are given in the table.

Total mortality throughout the season was 3·4 per cent. in the mixed plots as against 68·5 observed in the pure cotton control plots.

The results recorded in the above table show that mortality in the mixed crop is significantly lower than in pure cotton throughout ($t = 5{\cdot}36$). Soil and air temperatures were lower in the mixed crop while humidity was higher.[1]

Root-rot mortality in mixed and pure cotton plots

Week ending	Per cent. mortality	
	Cotton only	Cotton + Sorghum
20-6-39 ..	7·67	0·83
26-6-39 ..	12·47	0·34
3-7-39 ..	10·84	0·16
10-7-39 ..	4·84	0·08
17-7-39 ..	10·47	0·00
24-7-39 ..	12·10	0·00
31-7-39 ..	5·72	0·00
7-8-39 ..	12·47	0·00
14-8-39 ..	3·21	0·00
21-8-39 ..	2·12	0·00
30-8-39 ..	1·78	0·00
4-9-39 ..	1·20	0·00
11-9-39 ..	2·23	0·09

In another experiment, Desi cotton (variety Mollisoni 39) was sown on 14th of May, and Moth (*Phaseolus aconitifolius*) was sown between the cotton rows on the same day. A border of the same crop was also sown around cotton. Three plots were sown with mixed crop and the same number was put under pure cotton as checks. Along with root-rot mortality counts, soil and air temperatures were also recorded. The temperatures were lower in the mixed crop than in the pure and humidity was higher in the former. The mortality in cotton with moth was lower than in pure cotton, the difference being highly significant. It was further found that in the plots where moth was mixed with cotton, the root-rot mortality occurred during the first fortnight only and that too on spots where moth crop was thin. It will be seen that raising cotton either with sorghum or moth will reduce the incidence of root-rot disease. Moth is, however, more

suitable than sorghum, as it neither shades nor affects the growth of cotton plants.

JAI CHAND LUTHRA.
R. S. VASUDEVA.

Agricultural College and
Research Institute,
Lyallpur,
August 9, 1940.

[1] Vasudeva, R. S., *et al.*, *Ind. J. Agric. Sci.*, 1939, **9**, 595.

A Note on the Occurrence of Tri-Cotyledonary Seedlings in *Crotolaria juncia* Linn.

DURING the course of an investigation now in progress, seedlings of *Crotolaria juncia* were raised in the garden attached to the Bose Research Institute. Seeds were supplied by the Fibre Expert to the Government of Bengal, Dacca. Number of cotyledonary leaves in the seedlings were ordinarily two but few showed abnormal number of three cotyledons. It was found that multiplication of cotyledons in *C. juncia* were of frequent occurrence in the sample of seeds used during investigation. Seedlings which were subsequently raised at the Falta sub-station of the Institute also showed abnormality in the number of cotyledons. Out of 760 seedlings eight seedlings had three cotyledonary leaves. None of the cotyledonary leaves showed any sign of external distortion or splitting and were arranged symmetrically in a whorl.

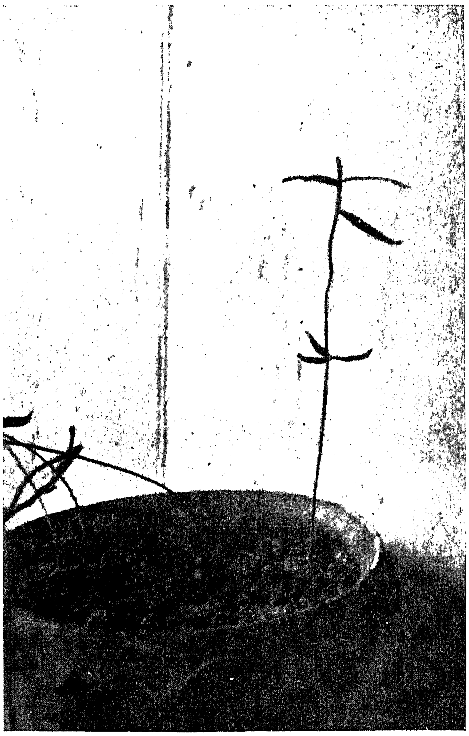

FIG. 1
Photograph of a seedling of *Crotolaria juncia* showing three cotyledons. × 1/3.

Multiplication of cotyledonary leaves have been noted in few angiosperms: *Acer pseudoplatanus*, *Cheiranthus cheiri*.[1] Abnormal number of cotyledons (3–5) have been noted in *Correa*, *Cratægus*.[2] Tri-cotyledonary seedlings have been noted in *Apium pteroselium* and few species of *solanum*.[2] In *Crotolaria juncia* faciation of inflorescence axis and of stem have only been noted.[3] Progenies of the tri-cotyledonary seedlings will be studied in the next generation and a detailed account will be published later.

K. K. PURKAYASTHA.

Bose Research Institute,
Calcutta,
September 11, 1940.

[1] Worsdell, *Principles of Plant Teratology*, 1915, **2**, 215.
[2] Masters, *Vegetable Plant Teratology* (*Lond. Roy. Soc.*), 1868, 370.
[3] T. C. N. Singh, *Journ. Ind. Bot. Soc.*, 1930, **9**, 250.

On the Origin and Distribution of Cloud Charges

OF the two important theories advanced to explain the production of electrical charges in thunder clouds, *viz.*, the "breaking drop" theory of Simpson and the "ion capture" theory of Wilson it has not yet been decided which is the process really in operation. It is generally considered that perhaps both are in operation. Simpson's theory[1] predicts negatively polarised clouds and Wilson's theory[2] predicts positively polarised clouds. In practice both are

observed. The observations of Banerji[3] in India are in accordance with Simpson's theory. Observations by other investigators[4,5] in England and Africa show a preponderance of positively polarised clouds. Recent balloon observations of Simpson[6] and field measurements of Wormell[7] in England confirm the preponderance of positively polarised clouds in that place. Hence the idea is gaining ground that the Wilson process is the more effective one in the formation of cloud electricity.

In the interpretation and discussion of the results one important factor seems to have been ignored. This is the influence of impurities in the water of clouds.

The purpose of this note is to point out the possibility of the formation of positively polarised clouds even by the Simpson mechanism. For this it is necessary to point out certain experimental results of J. J. Thomson[8] on the breaking of water drops in air. While distilled water develops a positive charge it was found that very small amounts of certain impurities dissolved in it entirely reverse the effect, the drops acquiring a negative charge. Thus Thomson gives the following results: 0·2 c.c. of H_2SO_4 in 1,000 c.c. of distilled water reverses the effect. A drop of hydrogen peroxide or methyl violet and other organic compounds not only reverses the effect but the amount of negative charge per c.c. is two or three times greater than the positive charge produced in distilled water.

Simpson developed his theory on the assumption that the water of the drops was pure. But if the drops of a cloud contain traces of impurities then there is an explanation of clouds with negative bottoms produced by Simpson's mechanism. In this connection it is interesting to point out the investigations of Schwend (quoted by Simpson[1]) on individual rain drops, which showed a marked mixing of drops having positive and negative charges. This seems to show that the kind of charge developed depends on the nature of each drop, perhaps the nature of the nucleus on which it condensed.

The important observation that the negative fields under positively polarised clouds are more intense than the positive fields under negatively polarised clouds can be explained by Thomson's observation that traces of some organic compounds as well as hydrogen peroxide greatly enhance the electrification in addition to reversing it. The large amount of charge in negative rain may be due to this also.

Now the chances of impurities likely to produce such effects are greater near cities and over oceans. This has some connection with the observation of Nukiyama and Noto[9] in Japan that in general coastal storm clouds have the Wilson distribution while the Simpson type is predominant in inland clouds. Hence the situation of a station seems to determine the polarity of clouds over it.

It is probable that the formation of traces of hydrogen peroxide may be the chief cause for the predominance of positively polarised clouds. The formation of hydrogen peroxide has been detected in rain. Besson[10] has shown its existence together with ozone in the heavy drops of rain as also in spray and evaporating water. Chlopin[11] found hydrogen peroxide in moist air exposed to ultra-violet radiation. Thus it seems that Simpson's mechanism will largely produce positively polarised clouds unless there are impurities which will destroy hydrogen peroxide. Hence it will be profitable to analyse rain water at various stations to see whether or not sufficient quantities of the above impurities exist to explain the reversal.

T. R. Jaya Raman.
Department of Electrical Technology,
Indian Institute of Science,
Bangalore,
September 17, 1940.

1 Simpson, G. C., *Proc. R. Soc.*, (A), 1926, **114**, 376.
2 Wilson, C. T. R., *J. Frank. Inst.*, 1920, **208**, 1.
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REVIEWS

Cosmic Rays. By R. A. Millikan. (Cambridge University Press, London), 1939. Pp. 134. Price 8*sh.* 6*d.*

This book is based on the lectures delivered by Prof. Millikan at Virginia in 1936 and at Dublin in 1937. The material, however, has been brought up to the date of publication in 1939. Though it deals largely with the work done by the cosmic ray group at the Norman Bridge Laboratory in Pasadena, the important conclusions arising out of the work of other schools are also considered.

The first few pages of the book are devoted to answering also the question "What are cosmic rays good for?", and incidentally also to some comments on world-affairs not wholly unconnected with the subject of the book. An excellent historical treatment of the growth of knowledge about electromagnetic radiation then follows. Starting from the earliest work of Gockel, Hess and Kolhorster, Professor Millikan gives a lucid account, not only of the subsequent results but also the reasoning by which they were reached. And in this treatment the frankness of the author is refreshing, specially with regard to his own work on the world survey of cosmic ray intensities. One can see evidence in almost every page of the rare experimental skill and unlimited perseverance of Prof. Millikan. His description of the Neher electroscope is a fine example of how closely the growth of knowledge in this field has been the result of new experimental techniques.

The various geomagnetic effects have been qualitatively treated and the conclusions that can be drawn from the experimental results about the primary cosmic ray spectrum, the nature of the particles and their probable origin have also been mentioned as far as our present knowledge permits. The cloud-chamber technique for photographing and measuring the energies of the cosmic ray particles has been described, and an account is given of the discovery of the positron. A non-mathematical treatment of the various processes of energy loss of charged particles traversing matter is given, as also a description of the cascade theory of shower production. In the text, this theory is attributed to Bethe and Heitler; actually, however, it was the paper of Bhabha and Heitler (1937) which first explained showers by a successive application of the phenomenon of Bremsstrahlung and pair creation. It might also be mentioned that statement 7 on page 54 might suggest that this process of shower production continues 'until the energy is all degraded into a very large number of lower and lower energy photons and electrons'. Actually, the loss by ionisation becomes the more important as soon as the energy falls below a critical amount depending on the nature of the matter traversed. (For air, this is about $1{\cdot}3 \times 10^{8}$ electron volts.)

The treatment of the meson component of the cosmic radiation in this book is rather inadequate. This was, however, inevitable as this part of the subject has been quite a recent development. C. V. RAMAN.

Annual Review of Physiology. By James Murray Luck and Victor E. Hull. (American Physiological Society and Annual Reviews Inc., California), 1939. Pp. v + 705. Price $5·00.

This is a new and welcome publication which has undertaken the difficult and responsible task of surveying the year's advances in the field of physiology. The success of such an enterprise depends upon the extent of willing co-operation of the foremost workers in the field, which the editors of the Review would be able to elicit and in the present instance, we may feel confident that under the editorship of Dr. Luck, who has a genius for organising such publications, these annual reviews will have a long and brilliant career of sustained excellence and usefulness.

The present volume covers practically every aspect of physiology; the energetics of physiological processes, the functioning of the vital organs and the tissues of the body and the physiology of the special senses, and the endocrine glands are all included. The volume has reviews on the progress of applied physiology and psychology. The field covered by the publication is thus wide and comprehensive.

We share with the editors the hope that "this new review will supplement the invaluable service which has been rendered for many years by *Physiological Reviews* and the *Ergibnisse der Physiologie*". The Annual Review is proposed to serve a somewhat different object; to give a broad resume of the significant work in the entire domain of physiology.

The Annual Review, by the very nature and variety of topics discussed, will attract the attention of a wide circle of scientific workers and we have every hope that this new venture will be crowned with the same degree of success which has attended the *Annual Review of Biochemistry*. M. S.

Chemicals of Commerce. By F. D. Snell and C. T. Snell. (Chapman & Hall, Ltd., London), 1940. Pp. viii + 540. Price 28*sh*.

This book is a useful descriptive compilation of classified commercial products of common or relatively common use though I rather doubt the suitability of calling many of them, *e.g.*, rubber, petroleum, etc., "chemicals". The field covered is wide but a comprehensive selection has been made and arranged in thirty-eight chapters, each of which deals with a different group of commercial substances, the individual specification of which is preceded by a general outline of the characteristic properties of the group.

In general, the book appears to me to be more particularly suited to the American reader, as U.S.A. standards, particularly U.S.A. pharmacopeial standards, are so frequently mentioned and the definition of proof strength is not that used in Great Britain or India, but there can be no doubt of its utility to the chemical profession.

I appreciated some sections of the book more than others and, in particular, the chapters giving information on Extracts of Natural Products, Essential Oils, Perfumes and similar classes, of which the authors seem to have a specialised knowledge and provide much information which it is frequently difficult to find. The arrangement of the items in these chapters as also in the tables given on pages 316–17, 428–29 and elsewhere could be improved while from that excellent feature, Appendix B, which 'translates' medical terms used in the text, I missed cathartic, echolic, excipient, genitourinary, laxative, nutrient, sternative and styptic.

In some instances, the information given does not appear to be quite up to date. For example, there is no mention of liquid hydrofluoric acid, buna, sulphurised oils, perchloron, maxchlor or power alcohol while the identity of teesol, agdite, pontol and hydronol might have been very useful to advisory chemists in any country experiencing difficulty in the matter of denaturants for alcohol, and a chapter on commercial solvents with their trade names, such as Westron, Westrosol, Dekalin, would have been welcome and a wider selection of new synthetic drugs would have appealed to certain classes of chemists.

I found it difficult to reconcile myself to such loose statements as the description of the ternary azeotropic mixture of alcohol, benzene and water, as a compound; chromium as both acidic and basic in its properties and the statement that no water is formed in the reaction of acetic anhydride with cellulose. Among technical errors observed were the value of ammonium nitrate in explosives, the action of carbon on barium sulphate and the definition of mortar.

The paper and printing are excellent though the splitting of words in the form, potas-sium, hy-droxide, hydrol-ysis, pred-ict and neces-sary, strike one strangely. There are singularly few spelling mistakes but I would invite attention to cocoa for Coca and propionic for propiolic and a few similar errors which might cause difficulties. Among the few incorrect formulas may be mentioned BaOH, $8H_2O$, the sodium molybdates and tungstates, orpiment which is As_2S_3, not As_2S_2, $(CH_3)_2C_6H_4OH$, $NH_2C_6H_6NHOCCH_3$ and $HOC_6H_4(NO_2)Cl$. Much repetition could have been avoided by a general statement to the effect that *o*-, *m*-, *p*- meant ortho, meta and para and α and β, alpha and beta. In some cases, the orientation of cyclic compounds is indicated and omitted in others, *e.g.*, T.N.T. and sodium picramate. I doubt if morpholine can be described as structurally similar to ethylene diamine.

As similar chemical dictionaries have appeared recently, I examined this work with great care but, although I have made rather a detailed criticism, it must not be concluded that there is not much of value in the work, including a considerable amount of newly classified information. It

seems to me, however, that the authors appear to have attempted rather too much in the compass of a single book and I feel that, in future editions, an expansion of each chapter and the addition of new ones will be found necessary until the work ultimately has to appear in several volumes.

My view, therefore, is that "Chemicals of Commerce" will prove valuable to professional chemists rather as an addition to the shelves of their libraries than as a comprehensive book of reference summarising the type of information suggested in its title.

H. B. DUNNICLIFF.

Phenomena at the Temperature of Liquid Helium. By E. F. Burton, H. Grayson Smith and J. O. Wilhelm. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1940, Pp. xi + 362. Price \$6.00.

In this book written for the American Chemical Society, Professor Burton and his colleagues of the McLennan low temperature laboratory of the University of Toronto give us a survey of all the work done at low temperatures till April 1939. The book is divided into eleven chapters. Four chapters are devoted to the low temperature technique, to explain how these low temperatures are produced and the method employed in measuring them. For a time, some theoretical calculations raised serious doubts whether the extreme low temperatures recorded (0·005° Curie) in adiabatic demagnetisation experiments were really attained. The mathematicians calculated on certain assumptions the probability for the transition of a quantum of magnetic energy into a quantum of thermal energy. This probability gives the time taken by the magnetic ions to be in equilibrium with the temperature of the crystal lattice. Fortunately for the experimenter he was able to determine these times experimentally and thus succeeded in showing that the calculations are wrong by a multiplying factor which is of the order of one thousand, and that the low temperatures recorded are really attained.

Four more chapters are devoted to describe the interesting phenomena of superconductivity and the peculiar properties of liquid helium. From the entropy temperature diagram between 0° and 4° K it is inferred that in the superconducting state the electrons contribute to the entropy as if they were the atoms of a solid, that is, as if they were reduced to an ordered configuration, and it is suggested that this order would probably be a regular distribution of velocities rather than a regular arrangement in position. The remaining chapters deal with our present ideas about the thermal and electrical conductivities, about magnetism and about specific heats. These we believe are included to make the book complete in itself and are presented in a way which is different from the routine and is yet original and simple. For example, the authors make a clear distinction between the contributions to the specific heat, of atomic and molecular vibrations (Debye), of atomic and molecular excitation (Schottky), of co-operative phenomena (Bragg-Williams and Bethe), and of conduction electrons in a metal (Sommerfeld).

The theoretical part of the book will be intelligible to anybody familiar with the principles of thermodynamics and of elementary quantum theory. There is also an exhaustive bibliography with about 700 references. The book can be read with advantage as an introduction to low temperature physics.

K. R. DIXIT.

Calculations of Quantitative Analysis. By Carl J. Engelder. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London), 1939. Pp. vi + 174. Price 12*sh*.

In an exact science like analytical chemistry, the theoretical principles and concepts can be reduced to mathematical terms, and hence the calculations involved in applying theory to practice constitute a very essential part of the study of quantitative analysis. The book under reference aims at covering and supplementing the usual course of elementary quantitative analysis with a set of graded problems. There are fifteen sets of twenty problems each, with correct final answers supplied for alternate problems only, this latter in order that the student can check for himself the correctness of his method of solution of problems. Each set of problems is preceded by a concise account of the theory and a few typical calculations.

The book is divided into four parts. Part I deals with introductory considerations, arithmetical operations and reagents in general. Part II which covers nearly half of the

book deals with calculations in volumetric analysis, including acidimetry and alkalimetry, volumetric precipitation analysis, and oxidation-reduction processes. Part III takes up the calculations involved in gravimetric technique, and Part IV concludes with the applications that are made of analytical data obtained by either volumetric or gravimetric methods.

Both teachers and students will find the book a helpful companion for the B.Sc. course. C. R. V.

Spectroscopy and Its Applications. *Proceedings of the Seventh Summer Conference on Spectroscopy and its Applications*, held at the Massachusetts Institute of Technology, Cambridge, Massachusetts, July 17–19, 1939. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1940. Pp. viii + 154. Price 16*sh*. 6*d*. net.

In this book we have a number of papers (twenty-eight to be exact) contributed by various authors to the Seventh Summer Conference of Spectroscopy and its Applications, called together by Prof. G. R. Harrison and held at the Massachusetts Institute of Technology. The papers deal mostly with the ever-widening field of application of spectroscopic methods. The extraordinary range of applications will best be appreciated by perusing the "alphabet of spectroscopy" given on pp. 7–9 of the book. There are papers dealing with the speed and accuracy of routine analyses carried out in several industries, *e.g.*, steel analysis at the Ford Company, analysis of ceramic materials, estimation of small traces of elements in fertilizers, determination of lead in blood and so on. Other papers deal with the sources, the dispersing instruments and the apparatus for the measurement of intensities, which is at the basis of quantitative spectrochemical analysis. Biological applications are covered by a number of papers and there is one paper on astrophysical applications. Although the several papers are not logically connected, and do not give a detailed survey of all the methods employed and results obtained, one can get a fair idea of the problems that are being tackled and the methods that are being developed, at first-hand. One could have wished for more details in certain instances and if it had been possible to include a summary of the discussions which the papers evoked, this wish would have been partly fulfilled. However, we must be grateful to Prof. Harrison for making the results of such congresses of specialists available to a much wider public. Here in India, some of the developing industries will profit materially by adopting spectrochemical methods of analysis and we should warmly recommend the book to those in authority in these industries. For the ordinary physicist, we are afraid, the price is too heavy, considering the extremely minute chance he has of obtaining any emoluments from professional consultations. But a perusal of the book will certainly correct the biassed view that much of modern physics taught at the Universities is a mere high-brow disquisition about atoms and quanta, without any fields of useful application. T. S. S.

Mathematical Tables, No. 1. (Statistical Laboratory, Calcutta), 1940. Pp. 30. Price Rs. 2.

These tables contain the values of n^r (for $r = 2, 3, 4, \frac{1}{2}, -\frac{1}{2}, -1$) and of $\log_{10} n$ from $n = 1$ to 1000. The values of $n^{\frac{1}{2}}$, $n^{-\frac{1}{2}}$ and $\log n$ are given to 7 places but those of n^{-1} are given to 9 places. The natural and logarithmic sines, cosines and tangents of angles from 0° to 90° are also tabulated to 7 places, at intervals of 0°·1. The inclusion of a table of values (to 5 decimal places) of e^x from $x = 1$ to 300 at intervals of ·01 is a useful feature. The figures in the last line of each page are repeated again in the first line of the next page; this duplication appears to be superfluous.

Though much of the material in this first number of these tables is easily available elsewhere, in conjunction with the further numbers yet to come and of which presumably the present number is the forerunner, these tables are sure to be of good use to all who have to deal with numerical data. The printing and get-up of the book are quite good. V. R. T.

EXCAVATIONS AT HARAPPA*

THE pre-historic mounds of Harappa are situated in the vicinity of the modern town of Harappa about fifteen miles from Montgomery in the Punjab. These mounds were known to antiquarians since 1826 and were officially reported on by Cunningham in 1873. The ruins had already been exploited for providing brick ballast for about a hundred miles of the Lahore-Multan railway and for bricks for the large number of houses of Harappa town. Steps were taken only in 1920 to protect the site under the Ancient Monuments Preservation Act, but by this time the vandalism of railway contractors had made a mess of the whole site. Systematic excavation of the mounds was begun and continued for three seasons by the late Rai Bahadur D. R. Sahni and afterwards from 1926 to 1934 by Mr. M. S. Vats, Deputy Director-General of Archæology in India, who has now published a most thorough, painstaking, and profusely illustrated monograph on the work done by the Department at Harappa.

Though Harappa lacked the affluence of Mohenjo-daro and its structural remains had been very much disturbed, the excavators were able to dig deeper at Harappa than at the other site, and discover lower strata that contained relics of the early centuries of the fourth millennium B.C. The most interesting of the antiquities from Harappa are the tiny seals and sealings of a very archaic character, from which the animal seals of the Indus civilization are believed to have evolved. Next to them in importance is the great state granary where grain received as taxes was probably stored up. Relics were also found of some palatial houses, with a frontage of over a hundred feet, designed "so as to separate the female apartments from the rest of the house". Wells were rare at Harappa, the inhabitants probably depending mostly on the river for their supply of drinking water. Drainage and conservancy arrangements were throughout the same as at Mohenjo-daro.

In addition to the usual chert implements known at Mohenjo-daro, from one of the early strata of Harappa came a granite celt which showed evidence of having been used. The copper tools were identical with those of Mohenjo-daro. A miniature copper chariot with gabled roof from another early stratum is considered by Mr. Vats to be the first example of a covered chariot from the Indus valley sites "antedating the earliest use of a wheeled vehicle in Egypt by several centuries".

Readers of *Current Science* will be specially interested in the report on the sixteen furnaces discovered at Harappa. None of them is complete, but enough remains to enable the excavator to form an idea of their shape, etc. One furnace was made of a cylindrical pottery jar imbedded in the earth. Others were round or pear-shaped and lined with bricks-on-edge and had vaulted roofs, and there is evidence to show that the ancient metallurgists of Harappa were able to maintain a very high temperature in their furnaces for casting their bronze and copper tools, for firing faience objects and for glazing their steatite seals and vessels. Khan Bahadur Sana Ullah has an interesting chapter on "the sources, composition and technique of copper and its alloys", and from a comparative study of the impurities in them he is able to establish definitely the sources of the metals used at Harappa.

Another outstanding discovery from the point of view of the history of science, is that of a graduated measuring rod of bronze with the divisions averaging about 0·934 cm. From a metric study of the structural remains Mr. Vats comes to the very interesting conclusion that the "Royal Cubit" of 20·7 inches and the foot of 13·2 inches were in vogue at Harappa.

It is of interest to note in passing that Harappa had about seven types of pottery lamps one of which is of the closed Roman type.

In the field of plastic art Harappa has a sensational item for the sceptically minded. It is a small statuette of a nude male, in red sandstone, from stratum III of Mound F. It recalls to mind the art of the Greek sculptors on account of its "wonderfully truthful modelling of the fleshy parts", but Mr. Vats shows very conclusively and beyond any possibility of doubt that this figure is Indian and pre-historic.

The excavators of Mohenjo-daro were regretful that they did not come across any

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* *Excavations at Harappa*. By Madho Sarup Vats, M.A. In two volumes with plans and plates. Vol. I.—Text, Vol. II.—139 Plates (Manager of Publications, Delhi) 1940. Price Rs. 50-6 or 77*s*., inclusive of Volume II.

extensive burials at that prehistoric city, for, burials are always psychologically revealing and give us, moderns an inkling into the faiths and beliefs of the dim distant past. Fortunately Mr. Vats discovered an extensive cemetery at Harappa with burials belonging to two distinct types, the earlier ones being what he has termed "earth burials" and the later ones "pot burials". In the mythological scenes painted on the burial jars, Mr. Vats finds many items of Indian beliefs, echoes of which are heard in the Vedas.

A. A.

LORD RUTHERFORD

Rutherford, being the Life and Letters of Lord Rutherford, O.M. By A. S. Eve, with a Foreword by Earl Baldwin of Bewdley. (Cambridge University Press, London), 1939. Pp. 451. Price 21*sh*.

THE Cavendish Professorship of experimental physics at Cambridge was occupied in succession by four outstanding men of genius and worldwide fame, namely, Clerk-Maxwell, Rayleigh, J. J. Thomson and Rutherford, whose work made an uneffaceable impression on science. Clerk-Maxwell was the first incumbent of the chair from 1871 to 1879, but his principal contributions to science were made at an earlier period. Rayleigh who succeeded him resigned in 1884 after a brief tenure of five years. He was succeeded by J. J. Thomson, then a young man only twenty-eight years of age. Both Clerk-Maxwell and Rayleigh were essentially individualists. The fame of the Cavendish Laboratory as a great centre of experimental research really dates from the year 1894 when J. J. Thomson turned his attention to the study of the discharge of electricity in gases. About this time, the University instituted a research degree open to any one who resided for two years and did an original investigation which received the approval of the examiners. The first research student to work under J. J. Thomson under this scheme was a young man from New Zealand who came to England with an 1851 Exhibition scholarship. That young student was Ernest Rutherford, who fittingly enough, succeeded J. J. Thomson twenty-four years later when the latter retired from the Cavendish Professorship in 1919. J. J. Thomson received the Nobel Prize for Physics in 1906, and Rutherford, the Nobel Prize for Chemistry in 1908. Their mortal remains now rest side by side at the Westminster Abbey in London where Britain's greatest men lie buried.

The fascinating story of Rutherford's remarkable life and career is well told in the biography which has been published by the Cambridge University Press. The book has been compiled by a friend and fellow-physicist in the person of Prof. A. S. Eve, F.R.S., who had been associated with Rutherford in the days of his earliest scientific triumphs at the McGill University in Canada and continued in close touch with him till the end. Much of the most interesting part of the book consists of extracts from the letters written by Rutherford himself to his wife and to his numerous friends and collaborators over a period of forty years. The care of Lady Rutherford in having preserved her husband's letters was indeed most fortunate, as they reveal Rutherford's personality in a remarkable way and tell the story of his life far more intimately and vividly than any biographer could have done.

The writer of this review well remembers his meeting Rutherford at the Cavendish Laboratory on the occasion of his first visit to England in 1921, and again on various occasions in 1924 and in 1929. He takes the opportunity of referring with pleasure and gratitude to the generous and friendly spirit manifested by Rutherford in his contacts with the writer. Many of Rutherford's letters to his friends were in his well-known and characteristic handwriting. It was the magnificent personality of Rutherford and his readiness to help the cause of science in every way, quite as much as the greatness of his own scientific work, which evoked the enthusiastic admiration of his colleagues and made him the towering figure he was in the world of science. The story of Rutherford's life and career cannot fail to be an inspiration to all students of science. The volume under review is one which may be heartily commended to every one who is interested in the triumphs of the human spirit in the world of Knowledge.

C. V. RAMAN.

CENTENARIES

Bugge, Thomas (1740-1815)

THOMAS BUGGE, a Danish astronomer, was born at Copenhagon, October 12, 1740. After a course in theology, he devoted himself to mathematics, astronomy, physics and mensuration. In 1761 he made observations on the transit of Venus. In 1777 he became professor of astronomy in the University of his native town. Next year he took charge of the observatory of the Round Tower. In 1798 he was deputed to work with the National Institute of Paris for securing uniformity of measures and weights.

The extreme accuracy of the excellent charts of Denmark, published by the Academy of Sciences, is mainly owing to him. His work on the coastal survey had considerable value. By his careful indication of every coast, harbour, island, rock and sand bank, the navigation of the Danish waters was made quite safe.

Bugge wrote more than a dozen papers of astronomical and geographical importance. The first of these was *Beskriveise over den Opmanlingsmethode som bruges ved de denske geographiske korter* (1779). The most used books of his are *De forste Grunde til den suhaeriske og theorestiske Astronomie, sand der mathematiske geographie* (1796) and *De forste Grunde til den rene eller abstracte Mathematic* 3 Dl. 1813 14.

Bugge died January 15, 1815.

Vigors, Nicholas Aylward (1785-1840)

NICHOLAS AYLWARD VIGORS, a British ornithologist, was born at Old Leighin in 1785. While he was at the Trinity College, Oxford, he wrote his *Enquiry into the nature and extent of poetick licence* which was published in 1810. After seeing military service in the Peninsular War, he qualified himself for the M.A. Degree in 1918. He was also created D.C.L. in 1832.

From early age Vigors had been forming extensive collections of birds and insects and these he presented to the Zoological Society which he helped in founding in 1826. He was the first secretary of the Society and held the office till 1833. His famous paper *On the natural affinities that connect the orders and families of birds* was published in 1819 in the *Transactions* of the Linnean Society. Between 1825 and 1836 he wrote some forty papers on ornithology. He assisted Sir William Jardine and Prideaux John Selby in their *Illustrations of ornithology* (1825–39) and wrote the section *Ornithology* for the *Zoology of Captain Beechy's voyage* (1839). He was also for some time joint editor of the *Zoological journal* (1828–35).

After sitting in Parliament for about eight years, as an advanced liberal, Vigors died at his house in Chester Terrace, Regent's Park, London, October 26, 1840.

Kohlrausch, Friedrich Wilhelm (1840-1910)

FRIEDRICH WILHELM KOHLRAUSCH, a German physicist, was born at Rinstein, October 14, 1840. Having studied at Gottingen and Erlangen, he became a professor of his University in 1866. After seeing some other appointments he became professor of physics in the University of Wurburg in 1875 and of Strassburg in 1888.

Physics was in the family so to speak. Kohlrausch's father was himself a physicist of great distinction. In conjunction with Weber he carried out for the first time a determination of the ratio of the electromagnetic to the electrostatic unit of electrical quantity and thus laid the foundation for the absolute system of electrical measurements. The son also specialised in the same subject. He also did much original work on the conductivity of solutions.

Kohlrausch wrote many papers and he is best known among students for his justly famous *Leitfaden der praktischen Physik* (1870) which was the first and also pronounced to be the best of its kind. It reached the eighth German edition in 1896 and went through two editions in English.

Kohlrausch died at Merburg, February 1910.

S. R. RANGANATHAN.

University Library,
Madras.

SCIENCE NOTES AND NEWS

Rare Fossils of Extinct Animals.—The discovery in the Badlands of South Dakota, of fossil bones of seventy-three specimens of extinct animals of the American West was announced recently by the *National Geographic Society*. The finds, many rare, and some probably new to science, were made by a paleontological expedition under the joint auspices of the Society and the South Dakota State School of Mines, under the leadership of Dr. Joseph P. Connolly, President of the School.

One of the outstanding specimens is the largest rhinoceros skull and jaws yet found in the Badlands, the skull approximately 28 inches long. Another is a pig skull and jaws, 30 inches long, probably a new genus; and still another the joined skull and jaws of a protoceros, a queer six-horned creature remotely related to deer and antelope. Leg bones of a bird which had a body larger than that of the domestic turkey of to-day are believed to have belonged to a wading bird comparable to a crane, of a previously unknown species. Bird bones are extremely rare in the Badlands formations.

Other important and interesting specimens found include a fossil egg not yet identified; and bones of three-toed horses about the size of sheep; peccaries; tapirs; oreodonts, small, long-tailed, cud-chewing animals; ancodonts, somewhat similar creatures; ancodus, a sort of pig-hippopotamus; a wild dog; a small insect-eating creature, apternodus, the fossil remains of which are extremely rare; and other insect-eaters, as well as rodents. An unusual discovery turned up several skulls of baby rhinos, their youth shown by their "milk teeth".

The Total Solar Eclipse of October 1.—The expedition organised by the *National Geographic Society* and the *National Bureau of Standards* to observe the total solar eclipse of October 1, will go down to history as one of the most carefully planned and best equipped expeditions. The observation post lay in the neighbourhood of the village of Patos, in the heart of one of Brazil's most important cotton growing regions, some 200 miles from Recife (Pernambuco), Brazil. The programme followed by the expedition included "a complete motion picture record, in colour, of the eclipse from the appearance of the first nick in the sun's disk until the moon completely passed across its face; photographs of the 'flash spectrum' of the sun at the two instants when this phenomenon is visible (just before the beginning and just after the end of totality); repeated photographs of the spectra of the corona during the five minutes of totality; special large photographs of the corona, both in black-and-white and in colour, with varying exposures; records of the polarization of the coronal light; radiation, sky spectra, and temperature and density changes in the atmosphere during totality".

The two spectrographs used by the expeditionists are of unusual design; they are slitless, using concave gratings and no lenses. One instrument was employed for photographing the spectrum between 3,000 and 5,500 Å and the other between 5,000 and 10,000 Å. One of the gratings with 15,000 lines to the inch was prepared by Robert W. Wood of John Hopkins, and the other by Henry G. Gale of the University of Chicago, had 30,000 lines to the inch. Almost all the instruments used for observation were "tied together" by a combined electric and vacuum control system, making the operation of the numerous units almost completely automatic.

The results of the expedition are awaited with much interest.

Adult Education in India.—Appendix III to the *Proceedings* of the fifth meeting of the **Central Advisory Board of Education in India** is really, for the most part, a Report on Adult Education in India, as indicated in its sub-title. The Committee which makes the Report was set up by the Central Advisory Board on Education in 1939.

Adult education is a problem in which not only officers of government but all persons interested in education must be well informed. Therefore a valuable Report such as this should be published in a form likely to attract the attention of the general public.

The first twenty pages of the booklet, which contains the main body of the Report, presents a most careful consideration of the problem of adult education in this country in all its aspects. To begin with, the problem is defined and distinguished from what goes on in Europe under the same name. Thereafter, various practical suggestions are offered in regard to the organization, technique, aids and appliances, preparation of teachers, and finally, administration and finance. No less than twenty-six separate recommendations are made, and with most of these the Advisory Board is in substantial agreement. The rest of the booklet is occupied with an account of the measures taken in recent years by the various provincial governments as well as by the governments of the larger Indian States in order to promote adult education.

It is sometimes complained that valuable official publications remain in obscurity because they are not well got up and given arresting titles. There is no doubt that this is the case here. The booklet is got up in a format which affords no clue as to the value of the material inside its covers. On the contrary, everything about the booklet is suggestive of matters of passing interest. The light is thus hidden under a bushel.

Appendix IV to *Proceedings* of the Fifth Meeting of the Central Advisory Board of Education in India, 1940, is a sister publication to the preceding one; and although it suffers from the same disadvantages as to title and format, they do not seem to matter very much here since the contents of the Report are of far less permanent value and far more controversial in character. It is, in fact, not a single Report, but two Reports under one cover, both dealing with the Wardha Education Scheme. There are also a few Appendices containing the opinions of certain bodies who have had to consider the scheme. A great deal is already known about the scheme and about the differences of opinion which prevail in regard to it. In these circumstances experience, not arguments, seems to offer the best guidance. Nevertheless, the Report is useful as part of the literature on what is known as Basic Education. D. S. GORDON.

Nutrition Research in India.—"Apart from specific contributions to science, the Coonoor research unit has since its inception laboured to put nutrition on the map in India and to-day the importance of nutrition to public health in India is generally realised," says a recent note on the work of the Nutrition Research Laboratories, Coonoor.

During the last five years, great attention has been paid to diet surveys and upto the present time over 60 diet surveys have been carried out in various parts of India. The main object of diet surveys is to discover the defects of Indian diets and indicate the changes and improvements which are desirable from the standpoint of nutrition. A considerable number of points of importance in connection with agricultural and public health policy have emerged as the result of the surveys and these have been summarised in a note which has been circulated to agricultural departments.

The Nutrition Advisory Committee is concerned with the development of nutrition work in India and includes as members the Public Health Commissioner, the Agricultural Commissioner and the Animal Husbandry Commissioner with the Government of India, the Director of the Nutrition Research Laboratories, some university professors of physiology and others with special interest in and knowledge of the subject.

The *Annual Report* for the year 1938–39 of the **Poona Irrigation and Hydrodynamic Research Station** (*Research Publication* No. 2, Manager of Publications, Delhi, 1940; pp. 323; Price Rs. 7–8–0 or 11*sh.* 6*d.*) gives an account of experiments undertaken during the year.

A curved approach channel and a raised sill have been indicated by experiments on models of the River Indus and Lloyd Barrage as a possible solution to reduce silting in the right bank canals, particularly in the north-western perennial canal. As a result of model experiments it was found that a spur 180 feet long sloping down at 1 in 5, pointing 35 degrees upstream would deflect the course of the River Watrak away from the north-west corner of the Kaira Town and thus afford the town ample protection.

Experiments are being conducted on a model of the Ganges above the Hardinge Bridge (E.B. Railway) with a view to reproduce the changes in the course of the river, the greatest difficulty being experienced in the correct reproduction of silt deposition which largely affects the river movements. To determine the best means of protecting bridge piers against scour, experiments are being carried out with special reference to the Hardinge Bridge. Training of the River Sarda above the barrage at Bannabassa and the River Jumna at New Delhi has continued to be the subject of model investigations.

The employment of the hot wire anemometer, generally used to record the speed variations in turbulent flow of air stream, will, it is believed, greatly aid the study of turbulent motion in water.

Part III of the *Report* dealing with several enquiries made of the Station from various parts of India and the recommendations suggested on a variety of problems is an evidence of the increasing appreciation of the usefulness of the Research Station. C. GOPALAKRISHNAN.

The Second Annual Meeting of the **Indian Chemical Manufacturers' Association** was held at Calcutta, on the 3rd October 1940, under the chairmanship of Sir P. C. Ray, the outgoing President. The President's address dealt with a number of subjects of importance to the Indian Chemical Industry. Sir P. C. Ray referred to the stimulus given by the war to the Heavy Chemical Industry. Many of the acids required are now being produced in India and the manufacture of other chemicals such as bleaching powder, caustic soda, etc., has been started on a small scale. If proper encouragement is given, these industries are bound to develop. Sir P. C. Ray pleaded for greater co-operation between manufacturing firms and research institutions. He suggested the formation of a *Chemical and Pharmaceutical Research Advisory Board*, consisting of representatives from Research Institutes and the Indian Chemical Manufacturers' Association.

Another subject referred to by the President was the difficulties the Pharmaceutical Industry had to contend with, such as unfavourable excise regulations, high railway freights and the activities of the Medical Stores Depots, which instead of being curtailed were being expanded. The attitude of the Government seems to be one of indifference. Sir P. C. Ray expressed his satisfaction at the passing of the Drugs Act of 1940, by the Government of India; he wondered, however, why representatives of the manufacturers were not included on the *Drugs Technical Advisory Board.*

It is pleasing to note that the membership of the Indian Chemical Manufacturers' Association has now increased to 32 and includes practically all the important firms in India engaged in Chemical Industry. The Association has done excellent work hitherto and it is to be hoped that it will continue to do so under the able guidance of its new President, Raj Mitra B. D. Amin. C. V.

Tuberculosis Association of India.—Consequent on the transfer of the work connected with the manufacture and issue of antirabic treatment, the Association of the Pasteur Institute have offered to place a major portion of their extensive estate at Kasauli, measuring about 30 acres in area, at the disposal of the Tuberculosis Association of India, free of cost, for the establishment of a Tuberculosis Sanatorium on such terms and conditions as may be mutually agreed upon.

The whole scheme for the establishment of the proposed sanatorium at Kasauli has been examined by an Advisory Committee appointed by Her Excellency the President of the Association.

The Sanatorium, when ready, will serve as a central institution for: (*a*) the modern treatment of pulmonary tuberculosis especially difficult cases requiring advanced surgical treatment; (*b*) the training of doctors, nurses and health visitors in the modern methods of diagnosis and treatment of the disease; and (*c*) research work in tuberculosis including bacteriological research.

The Standing Finance Committee of the Indian Legislature at its meeting held at Simla on September 9 and 10, has agreed to the grant of Rs. 3,25,000 (non-recurrent) and Rs. 20,000 (recurrent) to the Association, to cover the cost of establishment and maintenance of the Sanatorium.

A New Substitute for Jute.—According to the *J. Indian Chemical Society* (Industrial and News Edition), 1940, 3, No. 2, technical results obtained from *Macambira* fibre grown in Brazil show that it can be used successfully in manufacturing bags, canvas and a variety of products when mixed with the 'caroa' fibre. For both the fibres there is abundant raw material in Brazil. Industrial utilisation of these fibres was initiated by the Fabrica Yolanda, S.A.

The following students of the **Imperial Agricultural Research Institute**, New Delhi, have been awarded the Diploma of the Institute (*Assoc. I.A.R.I.*) after the completion in Septemper 1940, of their two-year post-graduate courses and the acceptance by the Institute Council of theses submitted by them as mentioned against each:—

Botany.—Mr. H. C. Mirchandani (A study in the variability of Afghanistan wheats). Mr. Y. R. Mehta (Studies in vernalization of mustard, gram and wheat). Mr. M. J. Deshmukh (Studies concerning the seed setting and agricultural value in berseem and allied species). Mr. Mohd. Jafar (An interspecific cross between *Triticum vulgare* Host and *Triticum vavilovi* Jakub: its segregation and importance). Mr. M. P. Narasimha Rao (Studies in Indian Oleiferous Brassicæ). Mr. Harbhajan Singh (I. Studies in the egg-plant *Solanum melongena* L.; II. Freezing experiments with some cultivated and wild potatoes).

Agricultural Chemistry.—Mr. K. C. Batra (Part I—Relationship between mechanical analysis and some single value constants; Part II—A comparative study of some more important ordinary and rapid methods of estimating exchangeable bases in soils). Mr. N. G. C. Iyengar (Biochemical studies on some Imperial Pusa wheats. Part I—The effect of fertilizer and cattle manure on the protein fractions; Part II—Differences in the chemical composition of some Pusa wheats grown on different soils). Mr. K. M. Mehta (Part I—The relationships between mechanical analysis, moisture equivalent and sticky point in Indian soils; Part II—Comparative study of some rapid chemical methods of estimating nitrogen and phosphorus in soils with the usual official methods. Mr. V. N. Prasad (Relationship between moisture equivalent, sticky point and clay content of soils).

The following students have successfully completed one year post-graduate course in Agriculture: Messrs. Jagdish Narain Misra, Ranbir Singh and N. Y. Karkare.

The New Hydraulic Laboratory of the National Research Council, Ottawa (Canada).—The National Research Council has recently provided in Ottawa, facilities for hydraulic structures research. Hon. J. A. MacKinnon, Chairman of the Committee of the Privy Council on Scientific and Industrial Research, which deals with matters of policy relating to the National Research Council, states that the laboratory has been set up on the recommendation and under the guidance of a Committee composed of technical representatives from four Dominion Government departments.

The new laboratory, which is a part of the Division of Mechanical Engineering, has been planned to supplement the limited facilities which are at present available in Canada for work of this kind. Space and equipment have been provided for model research on many classes of hydraulic structure to a scale, which will ensure correct flow conditions and freedom from uncertainty regarding "scale effect". The design of structures such as canal locks, dams, spillways, gates and power plant details can be investigated and work may be undertaken on river hydraulic problems of limited extent. Many pipe-flow problems are also within the scope of the laboratory. A feature of the laboratory is the large flow of water available which will be adequate for the largest models that can be accommodated. The present location of the hydraulic equipment is temporary, and the equipment has been designed for more commodious quarters for which plans have been made.

This hydraulic laboratory provides the engineering profession with a useful tool not hitherto available in Canada for the solution of many problems in hydraulic design. The new laboratory is provided to serve the needs of the country, and its facilities are available not only for investigations of national interest but also for the solution of those specific problems which arise in private industrial development.

A complete description with drawings, of the new hydraulic laboratory was published recently in *The Engineering Journal*. Reprints (N.R.C. No. 937) are available from the National Research Council at Ottawa.

ASTRONOMICAL NOTES

Transit of Mercury.—On November 11–12, will occur a transit of the planet Mercury across the Sun's disc. The egress only will be visible in India, the ingress happening before sunrise. At Madras the times of the interior and exterior contacts at egress are November 12, 7^h 23^m and 7^h 25^m a.m. respectively, Indian Standard Time. With some optical aid, the planet may be seen at sunrise, as a dark round spot near the north-western edge of the Sun's disc.

Planets during November 1940: Mercury after crossing the Sun's disc on November 12, passes into the morning sky and reaches greatest elongation west of the Sun (20° 11′) on November 29, when it will appear as a reddish star of magnitude 0·2. Venus will continue to be a bright object visible over the eastern horizon for about two hours and a half before sunrise. In the same part of the sky is Mars which although not so conspicuous, can be seen as a red star of the second magnitude.

Jupiter will be in opposition to the Sun on November 3, and will be at its brightest, the stellar magnitude during the month being −2·4. Saturn which continues to be apparently close to it, reaches opposition on November 4 and thus both the planets will be rising at about sunset this time and can be seen throughout the night. A close conjunction of Saturn with the moon will occur on the morning of November 14. In Taurus, about five degrees south of the cluster Pleiades, is Uranus which is in opposition to the Sun on November 16, and will be just visible to the naked eye as a faint star of the sixth magnitude.

Meteoric Showers: Two of the chief annual meteoric showers will occur during the month; the Leonids, about November 13–15 and the Andromedes, November 17–27. The radiant point of the Leonids is in R.A. 10^h 0^m Dec 22° N while that of the Andromedes is in R.A. 1^h 40^m Dec 43° N. It may be noted that the latter move in the path of Biela's Comet, which disintegrated and was last seen in 1852.

T. P. B.

SEISMOLOGICAL NOTES

During the month of September 1940, four moderate and six slight earthquake shocks were recorded by the Colaba seismographs as against one moderate and four slight ones recorded during the same month in 1939. Details for September 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	REMARKS
1940 Sept.		H.	M.	(Miles)		(Miles)	
3	Moderate	20	10	1550	Near 32°·0 N., 92°·5 E., to the north of Lhasa in Tibet		
4	Slight	01	27	1510			
5	Slight	00	41	1630			
12	Slight	05	51	3550			
12	Moderate	18	47	5550			
21	Moderate	19	19	1210	36° N., 71° E. in the Hindukush mountains	150 (approx.)	Felt severely in Peshawar and moderately in Lahore.
22	Slight	09	08	1650			
23	Moderate	04	22	3450	Near 9° N., 124° E., in the southern Philippine Islands	400 (approx.)	
25	Slight	01	02	1760			
26	Slight	09	26	5750			

MAGNETIC NOTES

The month of September 1940 was magnetically less disturbed than the previous month. There were 9 *quiet* days, 19 days of *slight* disturbance and 2 of *moderate* disturbance as compared with 11 quiet days, 17 days of slight disturbance and 2 of moderate disturbance during the same period of 1939.

The day of largest disturbance during the month of September 1940 was the 26th and that of least disturbance the 23rd. The characters assigned to individual days are shown below.

Quiet days	Disturbed days	
	Slight	Moderate
6, 10–13, 17, 23, 24, 29,	2–5, 7–9, 14–16, 18–22, 25, 27, 28, 30	1, 26

Magnetic Storms.—One moderate magnetic storm of short duration with a "sudden commencement" in all the three elements was recorded on the 26th September 1940. This is the only storm recorded during the month as compared with a moderate storm recorded during the month of September 1939.

The mean character figure for the month of September 1940 is 0·77 as against 0·70 for the same period of last year.

M. R. RANGASWAMI.

ANNOUNCEMENTS

Tuberculosis Association of India.—The Tuberculosis Association of India, with the co-operation of the Bombay Province Anti-Tuberculosis Association, will organise a medical post-graduate course for training in tuberculosis in Bombay, Panchgani and Wanlesswadi from the 13th January to 1st February 1941, both dates inclusive. During the first two weeks lectures and practical demonstrations will be held in Bombay at the Seth G. S. and Grant Medical Colleges and other institutions, and during the third week at the Tuberculosis Sanatoria in Panchgani and Wanlesswadi.

The class will be limited to 25 registered medical practitioners. Fifteen seats will be reserved for practitioners in Western India, including Indian States, and the remaining for candidates from other parts of India.

Applications for the course in prescribed form should reach the Secretary, Tuberculosis Association of India, New Delhi, by the 22nd November 1940.

The Tuberculosis Association also hope to organise a similar course in Calcutta early next year with the co-operation of the Bengal Tuberculosis Association.

International Congress of Pure and Applied Science.—The Second International Congress of Pure and Applied Science scheduled to be held at Columbia University, New York, in September 1940 has been postponed. As soon as possible, arrangements for the Congress will be made and a new date set by the Executive Committee after consultation with members of the National Committee. L. W. Tomarkin, Secretary-General, Columbia University, will continue to receive communications pertaining to the Congress.

The National Cancer Institute of the National Institute of Health of the U.S. Public Health Service, announces the establishment of *The Journal of the National Cancer Institute* as the official organ of the Institute. The new journal, which will be issued bi-monthly, will contain articles by the members of the staff on the various lines of cancer research work carried on by the Institute. The first issue will include papers on the federal cancer control programme, approaches to cancer research, the effect of various hydrocarbons in producing tumors in mice and studies on normal and cancerous tissues. The journal will be sold by the Superintendent of Documents, Government Printing Office, Washington, D.C. It will be distributed free to a limited number of medical schools, to workers in the field of cancer research, to research institutes interested in cancer, to a limited number of surgeons, as well as to certain government depositories and to journals making suitable exchanges.—(*Science*, 1940, 92, 2379.)

Microfilm Sets of Periodicals.—*The Committee on Scientific Aids to Learning*: President James B. Constant, of Harvard University, has made a grant to cover the cost of making microfilm master negative, on the most expensive film, of sets of volumes of scientific and learned journals.

This permits the non-profit Bibliofilm Service to supply microfilm copies at the sole positive copy cost, namely, one cent per page for odd volumes, or a special rate of half a cent per page for any properly copyable ten or more consecutive volumes.

The number of pages will be estimated on request to the American Documentation Institute, 2101, Constitution Avenue, Washington, D.C.—(*Chemical Reviews, June* 1940, p. 472.)

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 88, Nos. 4566–67.

"Agricultural Gazette of New South Wales," Vol. 51, Pt. 9.

"Indian Journal of Agricultural Science," Vol. 10, Pt. 4.

"Biochemical Journal," Vol. 34, No. 7.

"Journal of the Institute of Brewing," Vol. 46, No. 8.

"Biological Reviews," Vol. 15, No. 3.

"Journal of the Indian Chemical Society," Vol. 17, Nos. 6–7.

"Chemical Products," Vol. 3, Nos. 7–8.

"Comptes Rendus (Doklady)," Vol. 27, No. 4.

"Indian Forester," Vol. 66, No. 10.

"Indian Forest Records," Vol. 6, No. 4.

"Transactions of the Faraday Society," Vol. 36, No. 232.

"Indian Farming," Vol. 1, No. 9.

"Transactions of the Geological, Mining and Metallurgical Society of India," Vol. 12, No. 2.

"Bulletin of the Indian Central Jute Committee," Vol. 3, No. 6.

"Review of Applied Mycology," Vol. 19, Pt. 7.

"The Mathematics Student," Vol. 8, No. 2.

"The Bulletin of the American Meteorological Society," Vol. 21, No. 6.

"Indian Medical Gazette," Vol. 75, No. 9.

"Journal of the Indian Mathematical Society," Vol. 4, No. 3.

"Journal of the Mysore University," Vol. 1, Pts. 7–8.

"Journal of the Bombay Natural History Society," Vol. 41, No. 4.

"Journal of Nutrition," Vol. 20, No. 2.

"Nature," Vol. 146, Nos. 3690–93.

"Indian Journal of Physics," Vol. 14, Pt. 3.

"Canadian Journal of Research," Vol. 18, No. 7.

"Sky," Vol. 4, No. 10.

"Science and Culture," Vol. 6, No. 4.

"Indian Trade Journal," Vol. 138, Nos. 1777–89.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 10, Pt. 2.

"Arkiv Fur Zoologi," Band 32, Nos. 2–3.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences: (*Proceedings*)

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May 21.—G. NARASIMHAMURTHY: *Variation of butter constants due to ageing.*

June 19.—MAHDI HASSAN: *Pigment-producing bacteria.*

August 24.—K. C. SEN: *The Live-stock industry in India.*

September 28.—S. L. VENKITESWARAN: *Enzymic estimation of tyrosine.* P. L. N. RAO: *Sulphanilamide derivatives.* G. B. RAMASARMA AND B. N. BANERJEE: *Some factors affecting the vitamin content of mango fruit.*

Tin and Its Uses

The sixth issue of this Quarterly Review of the *International Tin Research and Development Council*, contains an illustrated article (page 4), describing a special tinning machine designed to produce more uniform and less porous tin coatings on tinplate. This machine embodies certain new features which are not yet employed in industrial practice, one of which is a device for securing a smooth drive for the rollers.

Another article (page 6) which is of particular interest at the present time, explains the uses of fusible alloys for the mounting of dies and punches for press-tool work, for foundry work and for bending tubes and sections.

An article (on page 11) entitled "Fluxes for Soldering" gives important information regarding the types of flux available and the uses to which each type is suited. Further details are given in this issue as to the best methods of ensuring adhesion of bearing metals to bearing shells of cast-iron and alloy steel.

Other articles give examples of technical difficulties encountered by tin consumers and of the Council's suggestions for overcoming them; this service of technical advice is available to any firm engaged on processes in which tin is involved.

ERRATUM

Vol 9, No. 9, September 1940: Supplement:

Article entitled "His Highness Maharaja Sri Jaya Chamaraja Wadiyar Bahadur," p. ii, column 2, third line, *for* "reigns" *read* "reins".

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CURRENT SCIENCE

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EUROPA ANGUSTIA

EXTERNAL CHARACTERS.—A new species of Phoenix; Size continental; Features varied; Capable of uttering songs and war cries; Food fish, olive leaves and gunpowder; Drink beer, petrol, lubricating oil of an aromatic nature; Beak highly cultured, maxilla red, longer than the yellow mandible, adapted for caressing and pecking; Teeth strangely heterodont, Jurassic sabres and grinders; Eyes, wider than the diameter of the metus, without lids, bluish, expressive of Christian meekness and pagan ferocity; Contour feathers, science, philosophy, art, poetry, religion; Colour cultural, golden yellow; Feathers on the neck erectile; The three divisions of the wings, all arms, aerial, naval and military; Pre-patagium, parachutelike; Remiges, 7, bombers, fighters, spitfires, hurricanes, tanks, machineguns and U-boats; Upper and under wing-coverts, diplomacy and politics; Rectrices, also 7, long-range guns, rifles, shells, handgrenades, bread baskets, beer bottles and incendiary rum flasks; Tail coverts secret pacts: Legs fifth columnists; Toes and claws three, adapted for holding the three Bases.

Internal characters.—Gastric mill an internal combustion engine; Heart, auricles fascist and U.S.S.R., ventricle democ.atic; Blood, blue, red, and Indian ink; High blood pressure; Occasional brain quakes; Tongue pointed, forked and patriotic, adapted for licking; Excretion, The League of Nations, Disarmament, Versailles.

Psychological characteristics.—A product of technological evolution; Temper sweet but uncertain; Neither reads the New Testament nor keeps the colon open; Visits pictures, haunts theatres; Fond of music; Thirst for gold insatiable.

Nesting habits.—Sex Hermomarsis, technological not biological; Material for nest building barbed wires; Recently laid two totalitarian eggs; Nestlings megalomaniacs, fed on rubber and scrap iron. From out of the ashes may arise a bird of paradise.

Illustration.—Cover page: Lord Raglan's book "The Science of Peace".

IF in the titanic struggle of 1914, the genius of the Rt.-Hon'ble Lloyd George triumphed, the British Empire may rest assured that its fortunes in the present conflict are absolutely safe in the hands of his political brother, the Rt.-Hon'ble Winston Churchill, whose boundless energy, amazing organising power and infectious enthusiasm are an indispensable national asset. In the present critical phase of the war, in which the stake is no less than the precious heritage of human liberty, the duty of every one to whom freedom is as dear as life, is obviously to stand solidly by Great Britain, the last citadel, which the implacable enemy has not succeeded in intimidating or overpowering into submission. The spirit of Britain is harder than steel, and the solidarity of the Empire is stronger than the most indissoluble amalgam. Her resources are inexhaustible. Her kick is more formidable than that of the Giraffe. The dictators are not unaware of the power of Britain, which will soon teach them to behave themselves.

The evolution of modern Europe is virtually the evolution of war technology, and it is not therefore surprising that nations regret that their genius has not been sufficiently harnessed for the invention of more formidable and more destructive engines, than are those employed in the present conflict. When in 1919 the statesmen of the victorious countries sat at the table in the Court of Versailles to draw up the instruments for implementing their war-born political faith of making the world safe for democracy, one could have almost heard the hoarse laughter of that spirit, whose name is unmentionable in polite society, at their unconsciously sowing seeds for a second European conflagration. The present travail of Europe is believed to herald the birth of another politico-social doctrine, to be christened "The New World Order", and this baby is expected to ensure for all the nations of Europe, Peace, Love, Justice and Independence, and to eliminate from their breasts the spirit of bad faith, treachery, intimidation and enslavement. But the War has to be won and won by Great Britain; at the present moment it promises to be long-drawn as was its immediate forerunner. The belligerents are not creating conditions for a speedy termination of the struggle, though the odds are decidedly in favour of the Empire. Her navy enjoys supremacy on the seas. Her military power can hardly be withstood. Her aerial arm is distinguished by the daring exploits which have confused and mastered the enemy's aircraft. The British nation is eager to meet the Nazi hordes and to give them a sound drubbing.

Everybody knows that a decisive victory is possible only after a land engagement. The whole coastline of Western Europe offers more than one point for the landing of an expeditionary force. Under such circumstances one of two things must be done, if the belligerents want to terminate the War. Accept risk, or redefine the terms of war.

The present conflict differs fundamentally from its classical predecessors. The reproach that wars generally place a premium on the uneugenic propagation of the race is now practically removed. We can hardly recollect any period in the history of mankind, when even the most savage enemy selected old men, women, children, schools, churches, hospitals, and art treasures as special targets for destruction, with the object either of creating confusion among the civil population or of breaking the spirit of Government's resistence. In the previous wars the flower of manhood and the excellent traits of national military character may have perished on the battle field, but they reappeared in the succeeding generation, because they are qualities more or less inherent in the national chromosomes. In the wholly indefensible and absurd slaughter of children, we might lose potential Newtons and Darwins; the favourable genes for producing them do not occur with the periodic frequency of planets in the Heavens. Nothing is more senseless than wars, and nothing is more easily or more carelessly provoked. Our religion is war-minded. Our culture is war-based. Our civilization is a war-product. Our mentality is war-tinged. We talk the language of peace, but tread the path of war.

In his work, "Paraphrases on the New Testament," Desiderius Erasmus has dedicated a passage to the Emperor Charles V, whose terrible significance is amazingly illustrated by the present European conflict.

> "May Your Majesty always remember that no war, however just the causes for which it is undertaken, can be carried on with such moderation that it shall not bring in its train a whole host of villainies and misfortunes, and that the evils of war fall, for the most part, upon the innocent."

Further in a letter addressed to a friend, he wrote:

> "I often wonder what it is that urges, I will not say Christians, but men, to such a pitch of madness that they will make every effort, incur expense and meet the greatest dangers, for their mutual destruction. For what else are we doing all our lives but waging war? We are worse than dumb animals, for among them it is only the wild beasts that wage war and even they do not fight among themselves, but with the beasts of a different species, and with weapons which nature has furnished them, not as we do with machines, invented by the art of devil, nor for all manner of causes but either in the defence of their young or for food."

Modern technological civilization and its by-product, Imperialism, have become sociophagous. It is no wonder therefore that, in the circumstances in which the international relations subsist to-day, wars are the inevitable arbiters of disputes provoked by economic rivalries and political jealousies, which are inseparable from the maladjustment of social organisations. The world must develop the spirit of the Eskimo or of the Mahatma, before it can even dream of universal and perpetual peace, love, goodwill and contentment. Dr. Nansen wrote of the Eskimo that "his peacefulness even goes so far that when anything is stolen from him, which seldom happens, he does not as a rule reclaim it, even if he knows who has

taken it". It would seem that the spirit of Christ after his crucifixion, must have selected Greenland as a more hospitable place for the inculcation of the true Christian doctrine of love, where the Heathens can astonish all Christendom by behaving like true Christians. Perhaps the jungle Veddahs of Ceylon are the clearest and the most successfully practical exponents of the impractical doctrine of non-violence. It may be argued that this spirit of pacifism has made these people stagnate, and that, as struggle is the indispensable accompaniment of progress, the hidden capacities of these people have lain dormant for centuries. The Eskimo and the Veddah have by a miracle escaped from the Law of Struggle and the Law of Survival, and this fact alone will entitle them to universal respect.

Within a short space of less than a year after the declaration of the War, Europe has witnessed the fall of some of the richest and the most prosperous kingdoms, and for the moment the Nazi nuisance has spread practically over all the European territories, leaving Great Britain and the remnants of her allies the terrible task of freeing the enslaved countries from the Fascist despotism. Victory may be achieved by one of two ways. He triumphs who sheds more human blood. But human blood behaves like the dragon's teeth. This is the meaning and movement of history. He also triumphs who produces a better plan of settlement. This is the meaning and essence of Christianity. We have tried several experiments for the preservation of Peace—Standing Armies, Armament, Politico-Economic Pacts, Missionaries, Democracy, Commonwealth, Nazism, Communism, Fascism, Revolutions, Republics. The New World Order talks of Politico-Economic adhesions, respect for the integrity of states, secured by co-operation based on loyalty to freedom and to the principles of democracy and for the defence of common interests. This is the old order phrased in a new language. The country that can produce "an order" which is more striking and which is calculated to wean the people of the totalitarian states from the politico-militarist milk of National Socialism, Gestapo and Concentration Camps, perhaps may win a bloodless victory. The articles of such an order would be: (*i*) No Standing Army. No Munition Factories. (*ii*) Every man to be respected as an absolute end in himself. (*iii*) No man to be used as a means for colonial expansion. (*iv*) Work for all. (*v*) Class prerogatives and hereditary privileges replaced by ability, character and power to develop peaceful and fruitful occupations. (*vi*) Conditions favouring economic rivalries, trade competitions, unemployment and political unrest discouraged. Our labours of successive civilizations have been like those of Sisyphus, and the history of political progress has been a circuitous folly. We have to place the wheels of human advancement on a new track, before we can hope to have peace for a reasonable term of our existence.

BLOOD GROUPS AND TYPES*

BY

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WHAT THEY ARE

MICROSCOPICALLY blood is seen to consist of (*i*) a watery colourless fluid, the *plasma*, and (*ii*) structures with definite shapes, the *blood cells and platelets*. Most of the structures are biconcave discs coloured yellow, the *red blood cells*, hereafter called *r.b.c.* In the r.b.c. there may exist one, both or neither of two group-specific substances, A and B. In the plasma there may exist one, both or neither of two anti-substances, a and b. A substance and its anti-substance cannot exist side by side in the same subject, because the r.b.c. containing the substance get stuck together, *agglutinated*, or even broken up, *lysed*, in the presence of the anti-substances in the plasma.

The only four combinations compatible with life are the four groups. They are:—

Substance in r.b.c.	Anti-substance in plasma	Designation of blood group in New Nomenclature	Designation of blood group in Old Nomenclature	
			Jansky	Moss
O (= nothing, capital letters)	ab	O	I	IV
A	b	A	II	II
B	a	B	III	III
AB	o (= nothing, small letters)	AB	IV	I

In the New Nomenclature the group is named after the substance. In a '*defective group*' an anti-substance which can exist is absent. The Old Nomenclature should now be forgotten.

HOW THEY ARE DETERMINED

When the blood is shed it clots. From the clot is squeezed out a straw-coloured watery fluid, the *serum*. In the serum are contained the anti-substances of the plasma. Only the serum containing a, serum a, and the serum containing b, serum b, are required. They will determine the four groups, thus:—

If only serum a agglutinates the unknown r.b.c., the group is A.

If only serum b agglutinates the unknown r.b.c., the group is B.

If both sera agglutinate the unknown r.b.c., the group is AB.

If neither serum agglutinates the unknown r.b.c., the group is O.

SUB-GROUPS

Group A is further divisible into A_1, A_2 and A_3 (Wiener, 1939), *sub-groups*, depending upon a full or a partial affinity only for serum a. A blood may thus be: O; A_1, A_2, and A_3; B; and A_1B, A_2B and A_3B (eight serological divisions instead of four).

TYPES

In addition but unrelated to the substances A and B there exist in the r.b.c. substances M and N. They differentiate three *types* within each group or sub-group, thus: OM, ON, OMN; A_1M, A_1N, A_1MN; A_2M, A_2N, A_2MN; A_3M, A_3N, A_3MN; BM, BN, BMN; A_1BM, A_1BN, A_1BMN; A_2BM, A_2BN, A_2BMN; and A_3BM, A_3BN, A_3BMN (24 serological divisions instead of 4 or 8).

In the M-N system there is nothing corresponding to O in the A-B system.

HOW TYPES ARE DETERMINED

The substances M and N belong to a class quite different from that of substances A and B. Normally there are no naturally occurring anti-substances corresponding to them in human blood. They are prepared in animals artificially. The principle involved is simple. From OM r.b.c. is prepared *anti OM serum*. The antiserum is absorbed with ON r.b.c. The residue left after absorption is *anti M fluid*. Similarly *anti N fluid* is prepared. The preparation in practice is rather wasteful and tedious (Greval, Chandra and Woodhead, 1939).

Knowing all about the groups, sub-groups and types it is possible to obtain one's own grouping sera and prepare one's own typing antifluids without any extraneous aid. It is

* In this communication technical terms needing explanation have been italicised close to the explanation.

much more convenient, however, to procure the material from laboratories stocking it, to begin with.

Blood Groups, Sub-Groups and Types in Transfusion of Blood and Skin Grafting

In transfusion the ideal arrangement is (*i*) that the recipient and the donor should belong to the same group and (*ii*) that the compatibility of bloods should be established *in vitro* by direct matching. In emergency all recipients can be transfused from a donor of group O, '*Universal Donor*'. Recipients AB, '*Universal Recipients*' can at all times be transfused from donors of all groups. Attention has recently been re-drawn to dangerous 'Universal Donors' (De Bakey & Honold, 1938). The same danger also exists in transfusing 'Universal Recipients'. The writer eliminates the danger (Greval and Chandra, 1939). The stored blood needed after air raids should come from safe universal donors. Very recently use of plasma has been recommended. The plasma can also be made safe.

The sub-groups have no significance in transfusion apart from the fact that they lead to error in grouping at times.

The types may have some significance in transfusion and may be responsible for incompatibility within the group as determined by direct matching (Greval and Chandra, *loc. cit.*).

In skin grafting and allied operations the consideration detailed above should also hold.

Blood Groups, Sub-Groups and Types in Genetics

O, A and B are all allelomorphs (contrasting characters). A and B are dominant while O is recessive. Mass statistics have shown that their inheritance follows the Mendelian Law. Further, A_1 is dominant over A_2 which is dominant over A_3.

M and N are both dominant.

Biological subtleties and speculations in genetics have found scope for operation when unexpected groups have turned up. The number of such unexpected occurrences has, however, steadily decreased with improvement in technique.

Blood Groups and Types in Forensic Medicine

From the groups of the parents all the possible groups of the offspring can be determined. It is possible to say that Master Tom *cannot* be the son of Mr. Smith. It is not possible to say that Master Tom *is* the son of Mr. Brown. All that an affirmative evidence can say is that Master Tom *can be* the son of Mr. Brown. The same remarks apply to Mrs. Smith and Mrs. Brown regarding motherhood.

Most workers in forensic medicine do not make use of sub-groups in determining parentage, because of difficulties of technique and consequent uncertainty of results.

M and N are easily determinable and may aid when groups have failed.

The writer has dealt with the question of inheritance of groups and types more fully elsewhere (Greval, 1939, 1940). The following tables give possible and impossible children.

TABLE I

Blood groups in parents and children

	Parents		Children possible	Children impossible
1	O	O	O	A, B, AB
2	O	A	O, A	B, AB
3	O	B	O, B	A, AB
4	A	A	O, A	B, AB
5	A	B	O, A, B, AB	..
6	B	B	O, B	A, AB
7	O	AB	A, B	O, AB
8	A	AB	A, B, AB	O
9	B	AB	A, B, AB	O
10	AB	AB	A, B, AB	O

TABLE II

Blood types in parents and children

	Parents		Children possible			Children impossible		
1	M	M	M	..	..	..	MN	N
2	M	MN	M	MN		..	..	N
3	M	N	..	MN	..	M	..	N
4	MN	MN	M	MN	N	..	..	..
5	MN	N		MN	N	M	..	..
6	N	N	..	..	N	M	MN	..

The group of a stain of blood can also be determined. It is possible to say whether

a stain can or cannot be derived from the blood of a certain person. Even the saliva may indicate the group.

BLOOD GROUPS AND TYPES IN ANTHROPOLOGY

The relative distribution of O, A and B, and M and N varies in different countries and communities. A predominates in European and B in Indian population. M and N show similar differences (Greval, Chandra and Woodhead, *loc. cit.*).

A view has been advanced that the original group in man is O, that A and B mutations have arisen in two different and distant foci, and that the present distribution has resulted from mingling of masses of humanity.

Immunologically, indications exist that A_2 and A_3 are nearer O than is A_1. Presumably they are nearer genetically too.

In a comparatively very small survey undertaken so far M and N have also shown marked differences in distribution. They too will indicate movements of masses of humanity when more is known about their distribution.

BLOOD GROUPS IN ANIMALS

Blood groups in animals also exist though they have not been yet worked out (Snyder, 1929). Interest in monkey gland having waned during the last decade, it can only be mentioned in a whisper that an exponent of rejuvenation passed through Calcutta a few years ago in search of monkeys, elsewhere, whose blood group corresponds as closely as possible to human group O. A graft from O is more likely to take and live than a graft from an unknown group which is likely to be different from the group of the subject rejuvenated.

Blood group distribution in the live-stock will presumably have a co-relation with biological qualities. Breeders may improve their stock by selection of blood groups in addition to or in place of selection of specimens.

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EDUCATION DEPARTMENT, OFFICE OF THE HIGH COMMISSIONER FOR INDIA, LONDON

DR. THOMAS QUAYLE'S Report on the activities of the Education Department of the Office of the High Commissioner for India (1938-39) is an impressive document and in the forwarding note we obtain glimpses of the tender solicitude with which the Department was looking after the welfare of Indian students in Great Britain when the international tension culminated in open hostilities in the final month of the year under review. At the beginning of the period there were about 1,514 students, including 131 women, pursuing full-time courses at Universities and Colleges throughout Great Britain, while there were also 113 students taking part-time courses in various branches. In Appendix V to the Report is given a long list of successes achieved by these students, and it is very gratifying to note that a fairly large number of academic honours have come to the share of women. Miss K. N. Bhagvat (Bombay) obtained the PH.D. (Cambridge) in Biochemistry, Miss D. H. Shahaney (United Provinces) was awarded the PH.D. (London) in Bacteriology as a student of the Imperial College of Science and Technology, Miss C. J. Dastur (Central Provinces) gained the B.LITT. degree in English at Oxford, Miss K. E. Bruen (a Government of Burma scholar) got the M.A. degree in Geography of London. In Surgery Miss V. Sankarambal (Mysore) passed the examination for the Fellowship of the Royal College of Surgeons, England. In Section III of this Report, particulars are furnished of the work done by the Department in collaboration with the Indian Stores Department, to find practical training in various branches of industry for the large number of students who each year seek these facilities. It is pointed out that the main difficulty in procuring these facilities arises, not from any racial discrimination, but is due, under pressure of intense trade competition, to the instinct of self-preservation. These trainees ought not to be looked upon as potential competitors, but as collaborators in the development of the Empire of which India is an equal partner.

OBITUARY

PROFESSOR M. T. NARANIENGAR, M.A.

THE numerous old students and the wide circle of mathematical colleagues of Professor M. T. Naraniengar must have received the sad news of his demise with profound sorrow. After a brief illness he passed away on October 9, 1940. India has lost a mathematician of rare ability and a gentleman distinguished for his piety and gentleness. He sought neither greatness nor public recognition, but both found him while unostentatiously discharging his duties. A brilliant graduate of the Madras University, he was early summoned to occupy the Professorial chair of Mathematics in the Central College, of which he was an *alumnus*. He held this post till he retired in 1925. He was one of the professors of the earlier generation who annexed to their teaching duties research work also, and in collaboration with the late Mr. V. Ramaswamy Iyer, he accepted the responsibility of founding the Indian Mathematical Society of whose official organ, he was the Editor from 1909 to 1927. As professor of Mathematics Mr. Naraniengar enjoyed unrivalled popularity and esteem, and as Editor of the *Journal of the Indian Mathematical Society*, he achieved a great reputation for the journal and distinction for himself. Its present international position and its recognised standard are largely the creation of his unstinted devotion to the service of the Society. What the Editor's duties implied may be gathered from his words: "Our main complaint was about the slovenly manner in which manuscripts were prepared and sent up. ... I had invariably to make press copies of questions and solutions, and to prepare diagrams drawn to scale for making blocks. The work of editing all the solutions to a single question would often involve several hours of close scrutiny and fair copying". These words show the scrupulous neatness and exactness on which the Editor insisted and how he exercised his vigilance over the form of presentation of mathematical problems is illustrated by the fact that he had had to return three times Ramanujan's article on "Some Properties of Bernoulli's Numbers", before it assumed an acceptable shape. In recognition of his distinguished services to the Society, an Address was presented to him on the occasion of the Silver Jubilee Celebrations at Bombay in 1932. He was President of the Trivandrum Session of the Indian Mathematical Conference. He shares with Dr. R. P. Paranjpye the distinction of being the first author of one of the first original papers, in mathematics published in India; and the stimulus which they have given has resulted in the establishment of flourishing schools of research practically in all the Indian Universities from which there is a steady flow of important research contributions. Mr. Naraniengar's greatness lay in infecting his young colleagues and pupils with a love as great as his own for original investigations in the different departments of mathematical enquiry. He was a man of few words, shy by nature, firm in principles, orthodox in habits and of a blameless record of work and character.

LETTERS TO THE EDITOR

A General Test for Finding whether Two Random Samples are Consubstantial*

The usual method of testing whether two random samples are consubstantial is to test whether the two samples differ significantly in their means; see *e.g.*, R. A. Fisher's "Statistical Methods for Research Workers". This test is accurate only in the case of samples drawn from a normally distributed population. A more general test was given by the writer some time ago.[2] This test too is not entirely free from a defect. However, the following test is quite as general and appears to be flawless. We will consider the simpler case of two equal samples.

Suppose the two samples, containing n individuals each, had been drawn from the same population. In this case each of the $2n$ individuals could have been drawn either in the first sample or in the second. Assuming for the time being that no two out of these $2n$ individuals are alike, it is clear that the pair of samples obtained by us is only one out of ${}_{2n}C_n/2$ different pairs of samples in which these very individuals could have been drawn. We will now classify these different possible samples in the following manner:

Let the individuals arranged in the order of increasing magnitude be a_1, a_2, ... a_{n-21}, a_{2n} and let $a_{\text{म}}$ be the median value of this sample.[1] We shall call an individual less than $a_{\text{म}}$ an "inferior individual". In general, in each pair of samples one will have more inferior individuals than the other. We shall term this sample the "inferior sample". (If the two samples have the same number of inferior individuals it is immaterial which of them is classed as an inferior sample).

We now divide the different pairs of samples into groups, such that the inferior samples in each group have the same number of inferior individuals. If we give a number to a group equal to the number of inferior individuals in one of its inferior samples, it is clear that the greater the number of a group the smaller is the frequency of pairs of samples in that group.

Assuming the total frequency of the pairs of samples in all these groups to be unity, the frequency of the pairs of samples in groups numbered m, $m+1$, $m+2$, ... and n is

$$f = 2\sum_{r=m}^{n} ({}_nC_r)^2/({}_{2n}C_n) \quad .. \quad .. \quad .. \quad \text{I}$$

By rejecting these groups as not belonging to our population the chance of our going wrong is f.

We thus deduce the following test:

Using some limit P for random chance we solve equation I for m after putting $f = \text{P}$. Let m_1 be the value.

If the number of inferior individuals in the inferior of our two samples is m_1 or more

* This word was used by Karl Pearson to mean "from the same population".

we say that on the limit P for random chance the two samples were not drawn from the same population.

It should be noted that this test is accurate when all the $2n$ individuals are different. It will, however, be shown in a fuller paper under preparation that even when two or more of the drawn individuals are alike, this test is true to a high degree of approximation in the long run.

We will now apply this test to the following case:—

N. A. F. Moos[2] showed that the observed value of P_0 in the year T during the period 1867–1904 can be "best" represented by $P_0 = -645 \cdot 10^{-5} - 68 \cdot 10^{-7} t$, where $t = T - 1865$. In other words, this implied a trend in the same direction.

To test the reality of the trend, the observed values of P_0 were divided into two groups from 1867–1885 in one group and the rest in the other.

The median of the 38 values $= -660 \times 10^{-5}$.

In the second sample (from 1867–85), which is the inferior sample, there are only 10 values less than the median.

Using 5 per cent. as our limit for random chance, *i.e.*, putting f, in equation I, equal to $0 \cdot 05$ and $n = 19$, we solve the equation for m. The value of $m = 14$.

Since the number of inferior individuals in the inferior sample is less than 14, we deduce that the two samples could have reasonably been obtained from the same population. That is to say, on the 5 per cent. limit for random chance the observed trend is not significant.

In conclusion it is hoped that the fuller paper, which is under preparation, will be sent for publication elsewhere before long.

S. R. Savur.

Tambyacha Bungla,
Colaba, Bombay 5,
October 28, 1940.

1 S. R. Savur, *Proc. Ind. Acad. Sci.*, (A.), 1937, pp. 569.
2 N. A. F. Moos, *Bombay Magnetic Observations*. 1846–1905, Part I. See page 5.

Constitution of Butrin

Butrin, the glycoside of the flavanone, butin, was isolated by Lal and Dutt[1] from the flowers of *Butea frondosa*. When hydrolysed with dilute sulphuric acid, it gives rise to a molecule of butin and two molecules of glucose. On treatment with excess of ethyl iodide and potassium carbonate, it was reported by Lal[2] to produce a diethyl ether. Assuming that under the conditions of the experiment only phenolic hydroxyl groups are attacked by ethyl iodide, he concluded that butrin was a bioside. In view of certain peculiar features exhibited by butrin its constitution interested us in connection with a general study of the constitution of anthoxanthin glycosides. On treatment with diazomethane, butrin yielded only a monomethyl ether and the latter on hydrolysis gave rise to a monomethyl derivative of butein. Hence the glycoside seems to be not a bioside but a diglucoside of butin, having the two sugar nuclei in two different positions. Experiments aimed at definitely establishing the positions of the glucose groups are under progress. Details will be published elsewhere.

P. Suryaprakasa Rao.

Chemistry Department,
Andhra University,
Waltair,
October 24, 1940.

1 Lal and Dutt, *J. I. C. S.*, 1935, **12**, 262.
2 Lal, *J. C. S.*, 1937, 1562.

Magnetic Susceptibilities of Some Halides

The magnetic susceptibilities of a number of fluorides, chlorides, bromides and iodides have been studied by various investigators.[1,2,3] However, several halides have still to be studied. A detailed investigation of some of these substances, has been started in this laboratory. Such an information not only fills the existing gap in our knowledge but also reveals interesting properties.

Mr. Chowdhery has already measured[4] the susceptibilities of some fluorides using Gouy's

method. The present investigation is a continuation of his work and some chlorides and oxychlorides have been studied. The experimental arrangement was the same as that used by him.

We give below the results obtained for the substances. The firm from which each of the following chemicals was obtained is given after the name of the chemical.

Compound	Temperature °C.	$X_m \times 10^6$
1. SbOCl (Antimony oxychloride) (British Drug House)	33·0	− 2·30
2. Carbon trichlorate $(CClO_3)_2$ (Theodre Schuchardt)	32·4	− 2·44
3. $PrCl_6 + H_2O$ (Praseodymium chloride) (Haen Works)	34·1	+ 0·18
4. $(C_5H_{11})_4NCl$ (Tetra-iso-amylammonium chloride) (Haen Works)	33·6	− 5·27
5. $C_2H_4(NH_2)_2$ HCl (Ethyldiamin hydrochloride) (Theodre Schuchardt)	30·6	− 0·79
6. Cr_2Cl_6 + aq (Chromic chloride) (Theodre Schuchardt)	31·0	+ 3·98
7. $FeCl_2 + H_2O$ (Iron chloride) (Haen Works)	34·2	+ 55·56
8. $CrCl_2$ (Chromium chloride) (Theodre Schuchardt)	33·8	+ 30·91
9. $TaCl_5$ (Tantalum chloride Sublimed) (Haen Works)	31·0	+ 0·39
10. $ThCl_4 + 8H_2O$ (Thorium chloride) (Merck)	32·2	− 0·34

Detailed account will be published elsewhere.

GHULAM FARID.

Physical Laboratories,
Muslim University,
Aligarh,
October 28, 1940.

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1 A. T. C., Paris, 1937, **8**.

2 *Ibid.*, 1937, **17**.

3 Landoldt and Bornstein, *Table of Constants*, Springer, Berlin, 1923–32.

4 A. A. Chowdhery, Aligarh Muslim University, *M.Sc. Dissertation*, 1940; *Curr. Sci.*, 1939, **8**, 550.

Vitamin Requirements of the Rice Moth *Corcyra cephalonica*, Staint (Lep.)

THE rice moth is essentially an insect which has a special preference to the starch-rich cereals. This significant circumstance justifies two assumptions. (1) Carbohydrate metabolism must dominate its life process, and (2) Vitamin B_1 requirements of the insect must be indispensable and substantial.

Experiments with a view to investigate the validity of these assumptions, were conducted. An attempt was made to maintain the insects on sago, which is obtained from the pith of palms and cycads in India.

The percentages of the more important constituents of sago and rice are given in Table I, which reveals the low content of protein, fat

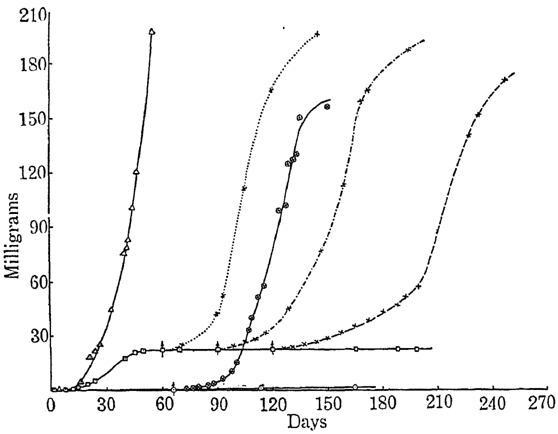
TABLE I

	Sago	Rice
Protein	0·13	7·3
Fat	0·10	1·6
Nitrogen-free Extract	78·16	73·3
Ash	0·16	1·0

and minerals in sago. It was, therefore, thought that sago might constitute a "basal" diet for nutrition work on these insects.

Insects, in batches of 25, were fed on sago; their weights taken at intervals. After 64 days, the insects were given sago which was supplemented by dried yeast to the extent of about 10 per cent. Several other batches of insects were started on a diet containing autoclaved (Vitamin B_1-free) yeast and after maintaining them for different periods on a Vitamin B_1-free diet, they were changed over to a Vitamin B_1 diet (provided in the form of unautoclaved yeast, 10 per cent.) after 30, 60 and 120 days respectively. Two batches of insects, were fed on the full Vitamin B_1 diet from the very commencement. The results are graphically represented in Fig. 1.

It will be seen from Fig. 1, that the insect larvæ, can be maintained on diet of sago but



Sago changed over to active yeast after 64 days of deficiency.

Vit. B_1 Free changed over to Vit. B_1 diet after 30 days of deficiency.

Vit. B_1 Free changed over to Vit. B_1 diet after 60 days of deficiency.

Vit. B_1 Free changed over to Vit. B_1 diet after 120 days of deficiency.

Vit. B_1 Diet.

Vit. B_1 Free Diet.

Sago.

practically, they do not put on any growth. When these "sago-fed" insects are transferred to a diet of yeast and sago, they begin to grow rapidly. Autoclaved yeast diet promotes the growth of the larvæ, during the first forty days to a small extent, but the growth comes to a dead stop after this period as will be seen from the curve. When batches of these insects are changed over to an unautoclaved-B_1-diet, the growth is resumed and the final weights which the larvæ attain, practically correspond to the weight reached by the batch of larvæ fed on the full diet from the very commencement.

It will, however, be observed, that the period for the attainment of the full growth, differs with the preceding period of "starvation" on a Vitamin B_1-free diet. It is remarkable that the insect should retain its power of recuperation after such a long period of starvation—a period, during which it should have, under normal conditions, gone through practically two generations.

B. G. L. Swamy.
M. Sreenivasaya.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
November 5, 1940.

The Nomenclature of Brassica Species

While there appears to be little confusion in Europe and in North America about the naming of turnips, swedes and rapes (see Table), in India the names for the oil-seed crops sarson and toria still seem to cause some trouble. Thus in a recent note [Mohammad and Sikka (1940)] toria is called *B. napus*, L. var. *dichotoma* Prain in the table and *B. campestris* L. var. *dichotoma* Prain in the text. If we first consider the nomenclature of European types (see Table), we can suggest that *B. campestris* L. should be reserved for types in which the chromosome number is $2n = 20$ and *B. napus* L. for types with a chromosome number of $2n = 38$.

Common name	Name according to Robson (1934)	Name according to Bailey (1922)	Somatic chromosome No.
White-fleshed swede	*B. napo-brassica* D. C.	*B. napo-brassica* Mill	38
Yellow-fleshed swede	*B. rutabaga* L.	*B. napo-brassica* Mill	38
Swede rape	*B. napus* L.	*B. napus* L.	38
White-fleshed turnip	*B. rapa* L.	*B. rapa* L.	20
Yellow-fleshed turnip	*B. rapa* L.	*B. rapa* L.	20
Turnip rape	*B. campestris* L.	*B. campestris* L.	20

Now both sarson and toria have a chromosome number of $2n = 20$ [Alam (1936)]. So it would appear that the botanical names should be *B. campestris* L. var. *sarson* and *B. campestris* L. var. *toria* respectively. The clumsy names, *B. campestris* subsp. *campestris* var. *dichotoma*

and *B. campestris* subsp. *napus* var. *toria*, as used by Alam (1936) should also be avoided.

It would also appear that one name only was needed for the two types of swede since these may differ by only two genes [Davey (1932)]. It is also possible to include both the swede rape and the swede in the same species and to call the swede *B. napus* L. var. *napobrassica* (L.) Petrm. (see Davey, 1932). It would seem, however, from comparison with the turnip species, to be useful to reserve *B. napus* for the swede rape and to call the swede itself *B. napobrassica* Mill.

In conclusion one would like to emphasise that in future the name *B. campestris* should be reserved for forms with $2n = 20$ and the name *B. napus* for forms with $2n = 38$. Forms with $2n = 20$ should not have the name *napus* in their botanical names.

H. W. HOWARD.

School of Agriculture,
Cambridge,
September 14, 1940.

Alam, Z., *Ann. Bot., London*, 1936, **50**, 85.
Bailey, L. H., *Gentes Herbarum, Fasc. II*, 1922, 53, Ithaka, New York.
Davey, V. McM., *J. Genet.*, 1932, **25**, 183.
Mohammad, A., and Sikka, S. M., *Curr. Sci.*, 1940, **9**, 280.
Robson, W. S., *Ann. Applied Biol.*, 1934 **21**, 418.

Diagenesis *versus* Mutation

A COMMON European insect, *Cicadella viridis*, contains two symbiotic micro-organisms. One belongs to the mysterious group, Cicadomyces, supposed to be allied to yeasts and found only among homopterous insects; and the other is a long bacterium. It has been explained[1] that the so-called Cicadomyces are but protoplasmic debris, while the real germs have hitherto been mistaken for cell-granules or pigment-granules. The long bacterium produces β-Carotene; the other bacterium forms short rods and produces an olive-yellow pigment whose chemical nature is unknown.

On cultivating the above bacteria from insect-tumours, or Bacteriotomes, formerly called mycotomes, they grow together. At first their joint pigmentation is bright yellow while after some three weeks there appear orange-red spots showing it to be a mixed colony. The yellow bacterium can be easily separated and in pure cultures gives rise to the greenish-yellow pigment. The red bacterium is always dependent on its yellow companion or is a commensal of the latter. Both bacteria belong to the group Mycobacteriaceæ. The bright yellow colouration of their colony is due to the mixed pigmentation of these two bacteria.

The red bacterium grows very slowly on all media tried so far and must be classed as dysgonic, whereas the yellow companion grows faster or is eugonic; these terms were first introduced in the study of the tubercular germ, also a species of Mycobacteriaceæ. When a commensal is at the same time dysgonic, *i.e.*, where one-sided symbiosis is accompanied by a differential rate of growth, a new phenomenon also appears. The impression gained on cultivating the micro-organisms of *Cicadella viridis* is that the red bacterium appears as a result of later contamination, whereas it is to be interpreted as latent infection, the dysgonic partner being present from the very beginning. Such a subsequent growth of another bacterium can be misinterpreted as an instance of mutation by an observer who took care to exclude all further chances of contamination. Such cases, I believe, have been actually reported in the literature as genuine mutations while critics have unduly stressed the possibility of a subsequent contamination having occurred in some mysterious way, both overlooking the probability of a latent infection. The importance of this phenomenon was kindly pointed out to me by my friend, Prof. Kollath of Rostock, who also suggested that a new term may be coined for the purpose. Epigenesis means, growing after, and would have been a suitable term but it is unfortunately preoccupied so that it is proposed to introduce the word Diagenesis. It signifies the deferred appearance, even after subculturing, of a latent infection where a dysgonic bacterium *grows through* (Dia = through) the main colony

which has been formed by its eugonic partner. Along with Diagenesis there may or may not be commensalism but the presence of a dysgonic partner is essential for this phenomenon. In this connection it may be reminded that while isolating germs from stool, soil or similar natural sources a commensal may grow independently since the medium supplied in the laboratory may be superior to that offered by nature which would make it difficult to ascertain if a diagenete is not also a commensal in its natural environment. Diagenesis might have been designated Pseudo-mutation but it is not so expressive.

When a tissue is considered sterile it implies that experiments to isolate germs possibly associated with it have all given negative results. The controversy if certain cell-inclusions, which on account of their size resemble cell granules, are real germs can only be decided by the application of the bacteriological technique. That is also the crux of the Cancer problem. In the same way if a germ is commensal or not depends upon the composition of the media tried. However the red bacterium seems to be a true commensal for even in the bacteriotomes of the insect, where it can be easily recognised on account of its large size, it is invariably associated with the short rods of its yellow partner. Buchner[2] unwittingly illustrates a Bacteriocyte (replacing the older designation Mycotocyte), with bacteria of two different sizes, long rods of the red and elongated dots of the yellow bacteria, whereas the picture is intended to represent only one kind of bacterium.

The isolation of these bacteria and ultimate separation of the red commensal was undertaken at the Institute of Hygiene, Leipzig, where the Director, Prof. Dresel, kindly offered all possible facilities. The famous Firm, Merck of Darmstadt sent me gratis some nicotinic acid amide, a costly substance, not available on the market, for which I am specially obliged. With the addition of nicotinic acid amide to prune juice agar the commensal grew independently. If the original medium were naturally rich in this substance no commensalism would have been noticed. The red pigment of the commensal easily distinguished it from the greenish-yellow pigment of the eugonic partner and it was really due to the differential pigmentation that the existence of a mixed infection became self-evident. If the probability of a latent infection be denied it is still more difficult to believe how a bacterium, even before it develops a large colony, would repeatedly give rise to an identical mutation. In fact the yellow bacterium, which is also the dominant one, in pure cultures has never produced a mutant. The red bacterium has done so and will be reported elsewhere. Pigment producing bacteria are rarely studied and those mentioned here also give a clue as to how, elsewhere, in a mixed colony where no pigment is formed, a diagenete may be easily mistaken for a genuine mutant. Even repeated sub-cultures would not assure the purity of a culture for it would not exclude the possibility of diagenesis. In such cases the technique of single cell culture alone must be resorted to in order to obtain a pure culture.

S. Mahdihassan.

Osmania Medical College,
Hyderabad (Dn.),
October 1, 1940.

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1 *Verhand. deutsch Zool. Ges.*, 1939, p. 420.
2 *Zeit. f. Morph. u. Oekologie*, 1925, **4**, 137.

Sugarcane Smut in Bihar

The existence of smut has been noted in Bihar this year during the months preceding the monsoon in parts where smut was not recorded before. The disease usually manifests itself after the monsoon when the cane is more or less mature and an earlier appearance is an indication of its severity. A few features of interest in this connection are described below:

In May when the crop was three months old thin cane stems with internodes varying from 1·5″–3″ in length could be seen in the affected shoots (Fig. 1). Butler's[1] suggestion that the smutted whip might be a floral shoot indicated that the development of the stem in the young diseased cane was probably a case of induced

Fig. 1
Stem formation in three months old cane with smutted whip

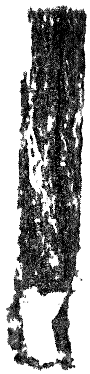

Fig. 2
Swollen base and corrugated [illegible] of smutted whip

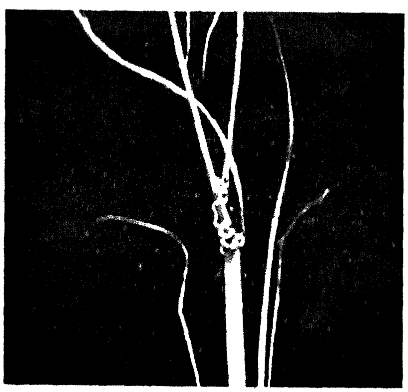

Fig. 3
Much coiled smutted whip. Below was a spike of flowers

maturity. During July interesting cases of spike formation were met with in the fields in five months old crop affected with smut—the spikes being borne on the younger shoots of the clump while the older ones were smutted. A very interesting case was one in which a flower-bearing spike terminated in a much coiled smutted whip which bore viable spores (Fig. 3).

It was observed in a few cases that the base of the whip has a swollen appearance, somewhat like a gall varying in diameter from 1″–2″ (Fig. 2). The spores were borne on the surface of the dark corrugated tissue. The sporiferous whips associated with the galls were short and stumpy and more or less erect while the normal whips were long, smooth and much curved on themselves.

Certain grubs were found voraciously feeding on the smut spores. A few of them were collected and fed on spores and a week later small beetles emerged from them. The beetles have been sent for identification. The rôle that they play in this disease is under investigation.

The collections of spores made from several localities were critically examined for morphologic variations. In colour, spore-wall, minutely punctate spore surface and mean diameter of the spores the collections from most of the parts agreed closely with *Ustilago scitaminia* Syd. One collection from Buxar in South Bihar, however, resembled *Ustilago scitaminia* Syd. var. *Sacchari-Barberi* Mundkur.[2]

S. A. Rafay.
S. Y. Padmanabhan.

Mycology Section,
Sugarcane Research Station,
Pusa, Bihar,
August 18, 1940.

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[1] Butler, E. J., *Fungi and Disease in Plants* (Thacker Spink & Co., Calcutta and Simla), 1918.
[2] Mundkur, B. B., *Kew Bul.*, 1939, No. 10.

A Malformation of Cotton Leaves

In the experimental plots on the study of the effect of time of sowing on the incidence of root-rot disease of cotton, the leaves of plants of Mollisoni 39 (*G. arboreum* var. *neglectum*) and the Punjab-American variety L.S.S. (*G. hirsutum*) cottons sown in the first week of

April were observed to have inward rolling of their margins. About 70 per cent. of the plants were affected. The first symptoms of curling of the leaves were observed in 1939, about four to five weeks after sowing (*i.e.*, about first week of May), but it occurred this year in a rather severe form. In the cottons sown in May, which is the normal time of sowing such curling of the leaves has been observed rarely. The leaves of last year's ratooned crop were also found to be affected.

The leaves may be partially rolled inward to form a sort of pocket or the entire margin of the leaves may turn inward to form a complete pouch. The first leaves appear to be almost normal but those formed later are thick, leathery in texture and are brittle. The diseased leaves are somewhat darker in colour than the normal leaves and if viewed against light the veins appear to be colourless.

After several weeks, the new leaves on the affected plants appear to be almost normal whereas the affected leaves are retained by the plants for sometime and further progress of the disease apparently, almost ceases. Later, the diseased leaves turn pale, dry up and are shed. This malformation seems to be different from that recorded by Mohammad Afzal[1] as it occurs in both indigenous and exotic varieties and as no diminution of plant organs is observed as plants advance in age. Fig. 1 shows healthy and affected plants.

FIG. 1

Healthy plant Affected plant

The affected leaves are histologically different from healthy leaves. The former are almost double the thickness as compared to the normal leaves. The epidermis of the affected leaves appear to be crumpled whereas in the normal leaves the epidermis and cuticle are regular and well-defined. The lower epidermis of the affected leaves showed irregular margins and this possibly explains the wrinkled appearance of the leaf surface. The palisade cells have comparatively more inter-cellular spaces and are almost 1¾ times the length in comparison to the normal healthy ones but in some places the palisade cells, rather than having developed

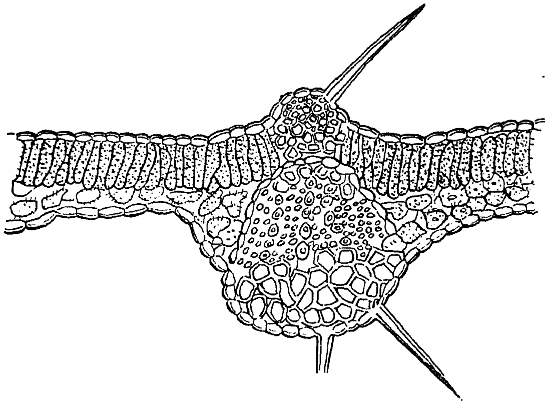


FIG. 2

Transverse Section of Healthy Cotton Leaf. (× 50)

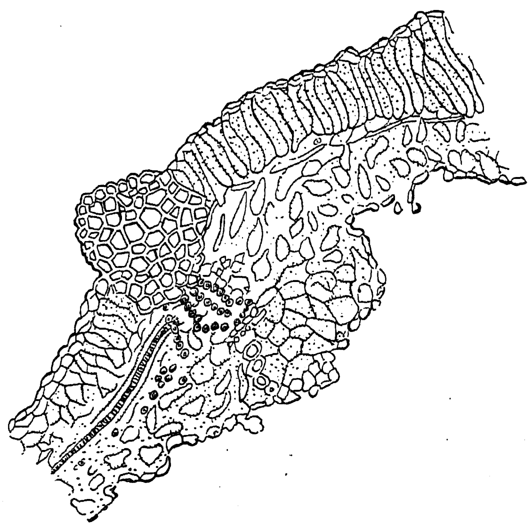


FIG. 3

Transverse Section of Affected Cotton Leaf. (× 50)

extra length, are distorted and irregular in shape. The spongy parenchyma in the diseased leaves is irregular and loosely arranged, so that there are many intercellular spaces. Plastids in the palisade cells of the affected leaves are very few and the cells appear almost colourless whereas the palisade cells of the healthy leaves are closely arranged and full of chloroplasts. The sclerenchyma cells of the mid-rib of diseased leaves are bigger but those of healthy leaves are smaller in size and compactly arranged. Figs. 2 and 3 show transverse sections through a healthy and an affected leaf respectively.

Table I gives the results of analysis of the healthy and affected leaves (mgm. per 100 gm.). Samples were collected from healthy and diseased plants standing close to each other in the same field and are comparable with respect to age, size and height.

TABLE I

	Fresh leaf materials			Dry leaf material	
	Total sugars	Reducing sugars	Sucrose	Starch	Nitrogen
Healthy ..	767	549	218	25·9	2·7
Diseased ..	590	466	124	20·7	1·1

The composition of the ash is given in Table II.

TABLE II

	Ash	Hcl. sol. ash	CaO	MgO	P_2O_5	Fe	K O	Na_2O
	Per cent. of dry material							
Healthy	19·25	17·12	5·12	0·80	0·81	0·11	3·64	0·13
Diseased	33·63	21·88	6·44	0·75	1·08	0·45	4·44	0·14

The data given above show that the affected leaves are characterised by (1) decrease in total sugars, reducing sugars, sucrose and starch, (2) lower nitrogen and (3) higher ash content.

Attempts to transmit the disease to healthy plants by the more usual methods have failed so far.

R. SAHAI VASUDEVA.

Department of Botany,
Agricultural Research Institute,
Lyallpur,
October 29, 1940.

[1] Mohammad Afzal, Santokh Singh Jaggi and Bishan Singh, *Ind. J. Agric. Sci.*, 1935, **5**, 624.

The Beneficial Effect of Boron on Jute

LAST year in the course of an investigation on jute plants grown in pots filled with manured soil and kept in open, it was noticed that many of the plants developed a characteristic injury; the topmost bud leaves and a few other assimilating leaves shrivelled and fell off; the apex of the stem also withered, became brown at first and ultimately blackened; the injury then spread downwards. This type of injury commonly designated 'dieback' was not observed in plants grown in a trial plot. Similar injury reported in literature, has been traced to (1) deficiency of boron,[1,2] potassium[3] or moisture[4] in the soil, (2) the addition of ammoniacal fertilizers[5] or (3) frost.[6]

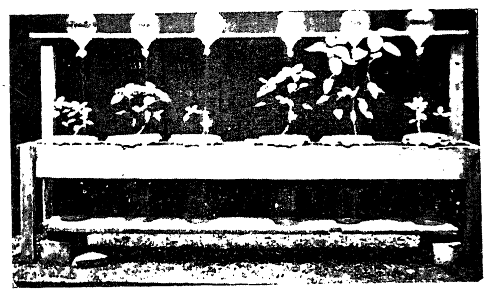


FIG. 1

Jute grown from seeds in sand culture with and without the addition of boric acid. The control is on the left. The plants on the right of this received respectively 0·01 p.p m., 10·0 p.p.m., 0·5 p.p.m., 0·1 p.p.m. and 1·0 p.p m. The plants were irrigated by the drip and drain method.

Jute (*Corchorus capsularis*) seeds were obtained from the Agri-Horticultural Society of Bengal and those with almost the same size and

weight were selected. They were soaked in distilled water for 10 to 15 minutes and 4 to 5 seeds were sown on 24th May in sterilised pots filled with boron-free sand and soaked in distilled water. When the seedlings were ten days old, the pots were thinned out, only 2 plants being allowed to remain in each pot; the pots irrigated with Hoagland's solution. Boron (as boric acid) was added in six different concentrations. The plants were grown for 42 days before harvesting. The first set of five plants was removed on the 16th July, the roots were washed free from sand and the lengths of stem and petiole taken. Readings of the surface area of the leaves were taken by a planimeter. The plants were then cut into tops and roots and the fresh and dry weights determined. These results are tabulated below.

TABLE I

Concentration of boron p.p.m.	Average of five plants						
	Total height cm.	Area of leaf sq. cm.	Length of petiole cm.	Fresh weight of plants gm.		Dry weight of plants gm.	
				Tops	Roots	Tops	Roots
	33·3	175·4	33·7	4·09	0·52	0·49	0·11
0·01	50·7	318·9	48·3	8·38	1·54	1·03	0·17
0·1	73·7	645·8	87·0	19·87	2·82	2·37	0·43
0·5	53·0	325·3	48·9	8·24	1·10	0·99	0·15
1·0	24·7	119·7	20·9	1·19	0·41	0·26	0·07
10·0	24·0	82·8	18·2	1·76	0·41	0·23	0·06
Control in composted soil	54·2	407·4	57·1	10·53	1·44	1·22	0·17

Plants receiving no boron were fairly healthy; only the leaves of the plants were not as green as those of plants receiving boron. Plants receiving concentrations of boron from as low as 0·01 p.p.m. to 0·5 p.p.m. were quite healthy. Those in pots receiving 0·1 p.p.m. of boron showed maximum growth. Higher concentration of boron proved distinctly toxic; thus those receiving 1 p.p.m. and 10 p.p.m. showed yellowing of leaves, the leaves themselves being deeply cupped on the under-surface. The growth was also poor. The special meristems in some cases died and the axillary buds that developed were all yellowish in colour. Roots were very poorly developed.

It was observed that all plants were prone to dieback, thus showing that this effect was not due to boron.

BENOY KRISHNA PALIT.
Bose Research Institute,
Calcutta,
September 10, 1940.

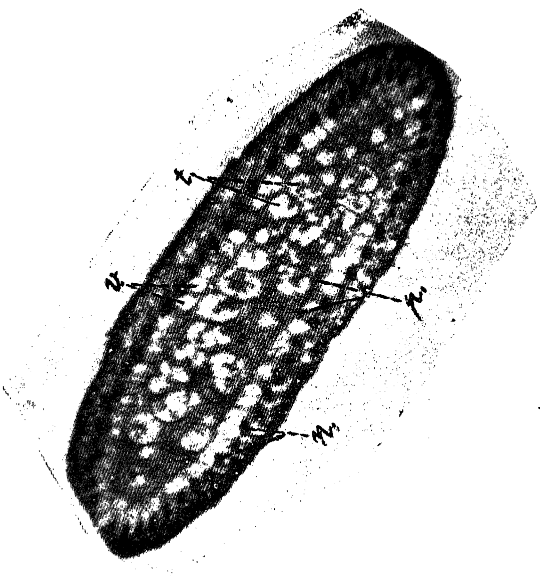
[1] McMurtrey, J. E., *J. Agri. Res.*, 1929, **38**, 371.
[2] Warington, K., *Ann. Bot.*, 1923, **37**, 329.
[3] Hartt, C. E., *Bot Gaz.*, 1929, **88**, 229.
[4] Heald, F. D., *Manual of Plant Diseases*, McGraw-Hill Book Co., Inc., 1933, p. 99.
[5] Floyd, B. F., *Fla. Agr. Exp. Sta. Bul.*, 1917, **140**, 1.
[6] Heald, F. D., *Manual of Plant Diseases*, McGraw-Hill Book Co., Inc., 1933, p. 169.

The Nervous System of a Proglottid of *Tentacularia macropora*

THE nervous system of Cestodes was first discovered by J. Muller[1] in *Tetrarhynchus attenuatus*. But in spite of the attempts of Lang,[2] Lönnberg,[3] Pintner[4] and Johnstone[5] the arrangement of the nerves in the proglottides in Tetrarhynchids is even now not known. The supposition is that there should be two lateral nerve cords running the whole length of the proglottid chain. The difficulty experienced by the students of the nervous system of invertebrates is more marked in the case of Cestodes. Most of the previous investigators seem to have either not employed the silver methods or have failed to obtain a sufficiently satisfactory impregnation of the fibres. This may probably be due to non-availability of sufficient material.

In March and July 1940 I obtained a number of *Tentacularia macropora* (Shipley and Hornell, 1906) from the spiral valve of *Stegostoma tigrinum*. After repeated experiments with the Bielchowsky technique I have obtained

some good impregnations of the nerve fibrils in the proglottides. The results are rather interesting. The nervous system is constituted in the proglottid by a large number of nerve cords all of which seem to be of equal thickness. Photo-micrograph is a transverse section of a maturing proglottid. It will be seen



that there are about 60 nerve cords (n). They lie outside the circular row of vitelline glands and fibres leaving these could be seen proceeding towards the cuticle as well as the organs in the medulla. Some of the fibres going towards the cuticle seem to innervate the subcuticular longitudinal muscles, while others end on the cuticle itself. The fibrils which proceed to innervate the organs in the medulla present a very curious arrangement. There is a fibrillar plexus (p) between the vitelline glands (v) and the testicular vesicles (t). This is formed by the individual fibrils of bundles leaving the nerve cord, separating after passing between the vitelline glands and forming a complex network. The plexus is thicker on the sides of the two large lateral excretory vessels than in the other regions. Innervation of the various organs is not by branches from the nerves but by fibrils from this plexus. Due to the formation of a plexus it is almost impossible to trace the nerve fibrils from the nerve cords to the tissue or organ innervated. Transverse sections show that some fibrils from the plexus also end in the cuticle.

From longitudinal sections it appears that the plexus is well marked only in the anterior half of the proglottid where testicular vesicles are present in the medulla. In the posterior half of the segment, the medulla has the appearance of a meshwork due to the presence of innumerable intercrossing fibrils. The ovary is innervated by bundles of fibrils proceeding directly from the nerve cords. Near the outer margin of the organ the fibrils separate and proceed to the various regions of the gland.

It will be seen that the nervous system is remarkably complex and not what was supposed to be the case by the previous authors. The nerve cords are not compact and neither do they appear to possess sheaths. There are no ganglionic enlargements and the ganglionic cells that occur are mostly bipolar. Considering the uniform environment in which these worms live and the strictly limited necessity for co-ordinated movement, the complex arrangement of nerve fibrils is rather surprising.

M. K. Subramaniam.

Department of Zoology,
University of Madras,
Triplicane, Madras,
October 20, 1940.

Magification of Photomicrograph × ca 100.

1 Muller, J., *Muller's Archiv. f Anat. Phys. Jahr.*, 1836.

2 Lang, A., *Mith d Zool. Stat. Neapel*, *Bd.* II, 1881, 372-400.

3 Lönnberg, E., *Bihang Till K. Svenska. Vet. Akad. Handl.*, 1889, **15.**

4 Pintner, Th., *Arb. a d Zool. Inst. d. Univ. Wien*, 1881; *Abstract in Jour. Roy. Micr. Soc. (2)*, 1831, **1**, 458–60.

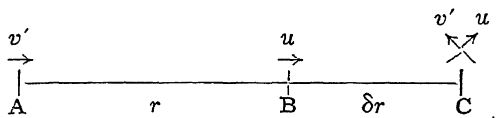
5 Johnstone, J., *Parasitology*, 1911, **4**, 364 416.

Some Observations on Sir Shah Sulaiman's Theories—II

In the December 1937 issue of *Current Science*, I published an analysis of Sir Shah Sulaiman's theories and gave some indications of their untenable character. The author of these theories was good enough to reply in the March 1938 issue of the same Journal. I now return to the subject once more and as I do not wish to consume much space, interested readers will kindly peruse the present article in conjunction with the other two referred to above.

1. Sir S. M. Sulaiman's view that relative velocity is a certain function of the individual velocities concerned and not their simple difference was scrutinised and elements of self-contradiction for his basic theory were illustrated through a particular formula adopted by him (and which he used to obtain Fresnel's Coefficient, etc.). In his reply the author expressed the idea that he was not concerned with the unavoidable "errors" in such formulæ (although I had throughout pointed out that they were *contradictory* of his premises and therefore altogether inadmissible) but that he could utilise any of them because the actual difference between individual velocities being, according to him, unobtainable, nothing really could exclude their use.

Here I shall endeavour, briefly, to establish that, as the foundations of Sir Shah Sulaiman's theory are the beliefs in absolute space and time (and as all varieties of Kinematics develop from assumptions as to these fundamentals), relative velocity and the difference between actual velocities must of logical necessity be one and the same thing.



Let there be two bodies with velocities, manner of departures and meeting points as indicated in the figure; we can get

$$\frac{r+\delta r}{v'}=\frac{\delta r}{u}\ (=t)$$

Eliminating δr, we have

$$\frac{r}{v'-u}=t \quad \ldots \quad \ldots \quad \ldots \quad \text{(i)}$$

The concept of relative velocity has nowhere been used to reach (i). Now, let us, as *different observers on the bodies*, taking the relative velocities of the bodies to be some indefinite function $f(v',u)$, perform the calculations. As space and time are assumed to be absolute, we will have

$$\frac{r}{f(v',u)}=t \quad \ldots \quad \ldots \quad \text{(ii)}$$

because observations in either case of time (and space) intervals by means of identically constructed clocks (and measuring rods) marking absolute time must be the same for two *distinct* events like the departure and meeting of two bodies. Whence $f(v',u) \equiv v'-u$. Further discussion follows.

How was Sir Shah Sulaiman led to his view? I think the clue to this is to be found in a remark of his, in the first two presentations of the theories, that Einstein might well have first hit at the relativity formula for relative velocity $\left(\frac{v'-u}{1-v'u/c^2}\right)$ and then "working *backwards*, reached the time and space relationships of his theory". Now the fact is that Einstein must first change fundamentally our ideas of time and space before he can logically arrive at the new formula for relative velocities (and other results). It is impossible to work "backwards" and reach new consistent laws of movement without first postulating a new scheme for spatiotemporal relations, for otherwise we will be compelled by logic to reject these *ad hoc* "Laws". Further, any expressions developed against the background of absolute space and time must, if they are logically consistent, relapse into classical kinematics or else reveal themselves as simply fantastic. And it must be remembered that the change introduced by Einstein in the classical relation comes in with the insertion of the factor $v'u/c^2$ which is the direct consequence of the new definition, in Special Relativity, of "common" time (see A. Einstein: *On the Electro-dynamics of moving bodies*, 1905) for two places, not in the immediate neighbourhood of one another, through the velocity of light. Even this Relativity formula, if $c \to \infty$, and thus space and time can be considered as absolute, gives $f(v',u) \equiv v'-u$. A newer and logically satisfying theory

of time would no doubt produce different consequences but Sir Shah Sulaiman has paid singularly scanty attention to this most important and involved problem. He comes to the subject once (casually) and calculates the total time spent by a messenger to traverse to-and-fro between two moving objects. This gives the time spent in the to-and-fro journey with the only novelty that the messenger's speed is D instead of something else. What is required, if a new view of kinematics is to be reached, is a fundamental and logical comprehension of "time" and not a unit or standard deviously evolved to measure absolute time's flow, which procedure merely mars the beauty and simplicity of the classical conception.

2. Sir Shah Sulaiman modifies Newton's law of gravitation on the ground that the speed of propagation of gravitational influence is finite —a contingency, according to Sir Shah Sulaiman, not reckoned by Newton—and therefore, it has to overtake the moving planets, etc.

I pointed out that, with the enormous speed, D, which Sir Shah Sulaiman ascribes to it, gravitational influence has already spread far and wide and there is no question of its overtaking, at least, the planets. Sir Shah Sulaiman has replied that I could have been right but unfortunately the solar system as a whole is moving through space and thus the modification is still needed.

Let us ignore the propriety of this belief and discuss the subject in itself. The objections are two-fold, the first in a narrow sense and the second of a different character.

(*a*) Though Sir Shah Sulaiman now justifies the modification in Newton's law on the ground of the motion of the solar system as a whole in space, he has throughout been using the velocities of the planets *relative* to the sun to reach particular results through the modified law, *e.g.*, the angular shifts in Mercury's perihelion positions.

It is indeed difficult to see why individual planets should behave differently according to this law, for it rests on what is common to all of them, namely, the motion of the solar system, regarded as a complex whole, through space.

(*b*) The object of investigation is to seek *the law* of gravitation and not expressions constructed to yield certain spectacular conclusions like the regular changes in Mercury's perihelion positions. Sir S. M. Sulaiman's formulæ cannot furnish the law for one can conspire to vary the nature and speed of the indefinite translation of the solar system through space taking care to correspondingly modify the mathematical expressions so as not to upset the possibility of deducing some celebrated results. Indeed Prof. Einstein himself touches on such possibilities in his Herbert Spencer Lecture at Oxford in 1933: *On the Method of Theoretical Physics* (Oxford University Press, 1933, Price 1*sh*.).

Lastly, Sir S. M. Sulaiman had attempted to construct his expressions for gravitation by using retarded potentials. It was pointed out in my previous paper that his method was, in effect, artificial substitutions, because the theory of retarded potentials cannot be genuinely applied where some of the vital factors are left unkown to be valued afterwards in attempts to deduce some famous results.

Gurgaon, (Punjab), ZAHUR HUSAIN.
July 29, 1940.

A New Comet-tail Band

IT is well-known that the comet-tail bands of CO^+ can be produced in a discharge tube containing helium and a trace of carbon. The presence of hydrogen, however, obliterates these bands but brings about the development of the so-called triplet carbon bands of CO. Since hydrogn can be either introduced or withdrawn by the suitable use of a palladium tube, the same discharge tube can be regulated so as to show either the one or the other of the two band systems belonging to the two molecules. Spectrograms of the triplet carbon bands with such a tube, in the far-red region show also a relatively intense band degraded towards the longer waves and having four heads like the comet-tail bands. Measurements show that it belongs indeed to the comet-tail system and fits into the existing analysis with vibrational quantum numbers (3, 3). The wave-numbers of the four heads observed and of second and fourth heads calculated on this

assignment according to the equation given by Herzberg[1] for this system are given below:—

Q. No.	ν vac. cm.$^{-1}$	
	Obs.	Calcd.
(3,3)	14027	..
	14010	14015·7
	13900	..
	13884	13890·7

The agreement is deemed satisfactory being well within the limits of accuracy of the equation and the measurements.

A search on the plates failed to reveal any band having $\nu \sim$ 14077 cm.$^{-1}$ which is the extrapolated value for the second head of a band immediately above the (0, 0) band in the $v'v''$ table, thus confirming the position given by Herzberg for the origin of the band system. The level A $^2\pi_{\frac{1}{2}}$, accordingly lies 1·94 e.volts above the ground state X $^2\Sigma$ of CO^+ and the excitation potential of the level starting from CO is 16·0 e.volts.*

R. K. Asundi.

Department of Physics,
Benares Hindu University,
October 30, 1940.

1. *Zeit. für Phys.*, 1929, **52**, 815.
* "This incidentally points out the obvious mistake, due evidently to oversight, in the values of the electronic and vibrational constants given for this level in almost all Reports on bandspectra except W. Weizel's Bandspectren, which mentions the correction necessitated by Herzberg's paper quoted here."

A Correction

In *Current Science* for August 1940 (p. 381), Mr. J. K. Bose of the Calcutta University (Department of Anthropology), has pointed out what he considers some fundamental mistakes in my paper on "A Proposed Classification of the Nasal Elevation Index".

The first mistake according to Mr. Bose was in my using the expression nasal "length" instead of nasal "height". I prefer to use "length" instead of "height" as the former, in my opinion, is much more appropriate than the latter for a description of the measurement involved. There are many anthropologists other than Martin, who have used the expression "nasal length" instead of "nasal height", among whom may be mentioned several of Mr. Bose's colleagues in the Calcutta University:—

(1) Prof. T. C. Das (President-elect of the Anthropology Section of the Indian Science Congress next year) in his paper on "The Wild Kharias of Dhalbhum", published by the Calcutta University, 1931, used the term nasal length instead of height (p. 4). In another paper entitled "The Bhumijas of Seraikella" the same writer used nasal length instead of height (Pls. VIII, IX, X, XII).

(2) Prof. T. C. Raichaudhuri, of the Calcutta University, I find, has also used nose-length in place of height in his paper on "The Khasis", published in the *Cal. Univ. Jour.*, Dept. Letters, XXVI (pp. 249, 252, 257, 261, etc.).

(3) Mr. M. N. Basu, also of the Calcutta University, has done the same both in his paper on "The Bunas of Bengal", published by the Calcutta University, 1939 (pp. 10, 17) and in his *An Introduction to Anthropology* (Calcutta, 1936), written in association with Mr. R. K Mondal (p. 146). And last, but not the least, may I take the liberty of informing Mr. Bose that he himself has used this expression? On page 71 (1936) of his well-known work entitled "A Handbook of Anthropology" which is prescribed as a text-book for the I.Sc. and B.Sc. examinations in Anthropology of the Calcutta University, Mr. J. K. Bose himself uses the term "length of the nose" instead of "height".

All these works were published subsequent to the Monaco agreement of 1905 and the appearance of the second edition of Martin's *Lehrbuch* in 1928. Mr. J. K. Bose can have no excuse in not following these authorities cited by himself against me, as his work was written fully 21 and 8 years respectively after the publication of the above works.

I am, however, very grateful to him for drawing my attention to the substitution of the word "nasospinale" for "subnasale" a mistake detected long ago but too late to enable me to annex an erratum in the same issue of the *Journal*. Corrections in ink were, however, made afterwards in the copies of the *Journal* before they were sent out.

S. S. Sarkar.

Bose Institute, Calcutta,
September 14, 1940.

REVIEWS

The Story of Astronomy. By Arthur L. Draper and Marian Lockwood. (George Allen & Unwin, Ltd., London), 1940. Pp. 394. Price 12*sh.* 6*d.*

In this interesting work, the authors have attempted to present, within the limits of a single volume, a concise account of the principal facts of astronomy in a manner suitable to the requirements of the general reader. During recent years, the progress of knowledge in the several branches has taken rapid strides and surveys like the present one are useful in making the information gained by research available to the layman and in giving him an insight into the trends of modern astronomical thought. The book under review possesses certain distinctive features. The authors are curators of the famous Hayden Planetarium, New York, and have wide experience of popular exposition of astronomical topics —a fact which seems to have had considerable influence in the arrangement of material and the method of presentation. The style is simple, the descriptions are vivid and of the guide-book type; and the treatment of most of the topics is adequate for a beginner in the subject.

The book opens with a brief introduction giving the story of astronomy from the earliest beginnings veiled in mythology and legend. The second chapter explains clearly the phenomena connected with the celestial sphere and introduces the idea of parallax. The next chapter is concerned with a general description of telescopes, in the historical order of development, the use of the spectroscope in astronomical observations and the application of photographic methods. The six chapters that follow, deal with the moon, the sun, the solar system, and comets and meteors; and the important facts that are known at present, about these bodies, are set forth in a concise form. The information is generally up-to-date, but it is curious that while describing the solar corona (p. 117), no mention is made of B. Lyots' admirable work on the photography of the corona in the absence of a total eclipse.

Chapters 10–13 are devoted to a variety of topics—stars and their motions, variable stars, novæ and dark stars, star clusters and galactic nebulæ; while in Chapter 14, we have a summary of our present knowledge of the Milky Way and its structure and the phenomenon of galactic rotation.

Next follows an excellent chapter on the spiral and other extra—galactic nebulæ—those remarkable objects that are scattered far out in space beyond the boundaries of our Milky Way system—and the problem of the red-shift of the spectral lines is briefly discussed. The concluding chapter contains short popular expositions of Einstein's theory of relativity and its astronomical consequences, and the conception of an expanding Universe formulated by Lemaitre.

The titles of some of the chapters may appear somewhat novel and read like the head lines in newspapers, as Skyward Ho, Queer Kinds of Stars, Comets and Meteors—Riff Raff of the Sky. The book is on the whole, well written and will form a valuable addition to popular astronomical literature. The get-up is excellent and there are a number of beautiful photographs reproduced to illustrate the text. T. P. B.

Sound. By E. G. Richardson. (Edward Arnold & Co., London), 1940. Third Edition. Pp. iv + 339. Price 16*sh.*

This is a well-known standard book on sound suitable for the degree and honours examinations of our universities. The new chapters that were added in the second edition on impedance, ultrasonics and sound reproduction, have been, in the present edition further extended and brought up to date since it is in these departments that most of the research work in acoustics, in the past few years, has taken place.

The first chapter which deals with the velocity of sound in air, begins with the derivation of Newton's formula and the Laplacian correction. All the experimental methods relating to these are next dealt with, at sufficient length. Sound photography by the Toepters method has been given with details. Anomalous propagation of explosive sounds as well as that of sound in tubes are next treated. The second chapter deals with the mathematics of vibrating systems and their experimental verification, simple harmonic motions, Fourier analysis,

progressive and stationary waves, Lissajous vibrations, undamped and damped, free and forced as well as resonance and reaction in coupled systems and theories of combination tones. Longitudinal and torsional vibrations, transverse vibration of strings and rods form the subject-matter of chapters three and four. The different methods of studying vibrations,—graphic, photographic and stroboscopic—are considered at great length. The interesting "chattering method" of W. H. Bragg for study of small vibrations, such as those of membranes is also included. Then follow, in considerable detail, the study of plucked strings, bowed strings and struck strings. Vibrations of bars, tuning forks, membranes and plates are followed by an account of vortex formation and Acolian tones, subjects of special interest to the author of the book. Vibrations in columns of air as in tubes, pipes, musical instruments like flute, clarionet, oboe bugle and trombone are treated in detail. Heat-maintained sound, analysis of sound in air by means of recorders, resonators and absolute pressure measurements form the contents of the next two chapters.

When a steady force is applied to a body in a conduit, tending to move it along the conduit, there exists a definite relation between the applied pressure and the current produced, called the resistance; this resistance is due to viscosity. When the applied pressure is alternating, viscosity is not the only force opposing the movement of the gas; there is also a factor depending on the frequency. The ratio between the applied pressure and the velocity produced by it, in the more general case, is known as the acoustic impedance by analogy with the electrical impedance, which is the applied electromotive force divided by the current produced by it. This subject is of great interest to the author of the book and the account given is very good. Particular mention may be made of the accounts given of the "annular effect" discovered by the author in tubes subjected to aerial oscillations and the several methods devised by him, his students and others to study impedances. Ultrasonics and subjective sound are next treated followed by the chapter on technology dealing with acoustics of buildings, sound rangings, direction findings, propagation of sound through the earth and echo prospecting.

B. DASANNACHARYA.

Fundamental Processes of Electrical Discharge in Gases. By Leonard B. Loeb. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London), 1939. Pp. 717. Price 42*sh*.

The publication of this book is very opportune. The field of study of electrical discharge in gases has had a historical development quite unique in some respects. With its beginning in the days of the discovery of X-rays (1895) and of the electron (1896), it developed with great rapidity in the ensuing fifteen years. By 1911 and 1914 J. J. Thomson and J. S. Townsend co-ordinated and correlated the many studies in their two classics, the *Conduction of Electricity through Gases,* and *Electricity through Gases*. Due, however, to some technical difficulties and the more interesting developments in the fields of atomic theory, X-rays, ionizing impacts, radioactivity, spectroscopy, etc., the interest in discharge phenomena was not sustained.

Thanks to the technical improvements made possible by the introduction of the pyrex glass, better pumps, induction furnaces, electron tubes and oscillographs the interest in this field has been revived during the past fifteen years. The excellent text-book of V. Engel and Steenbeck, which appeared not very long ago, though quite modern and authoritative, is defective in that the author presents only his own considered views on most of the controversial subjects. In the book under review Prof. Loeb tries to present the reader with all the facts and the several conflicting views, and thereafter throws the weight of his authority in whatever direction it should, in his opinion, go, giving his reasons in each instance. In many of the fields studied the author and his students have been engaged in experimental investigations over periods of many years at the California Institute of Technology.

The subjects dealt with are: Ionic Mobilities, Recombination of Ions, Diffusion of Ions, Electron Mobility, Distribution of Electron Energies in a Gas in Electrical Field, Formation of Negative Iions, Ionization Currents in Gases in Fields below Ionization by Collision, Ionization by Collision by Electron in a Gas, Second Townsend Coefficient, Disruptive Discharge in Gases, Sparks, the Arc and Glow Discharge.

B. DASANNACHARYA.

Indian Indigenous Milk Products. By W. L. Davies. (Thacker, Spink & Co., Ltd., Calcutta), 1940. Pp. vi + 96. Price Rs. 1–8–0.

"The main theme of the book is the full nutritional and commercial exploitation of milk." It presents in a surprisingly small compass all the important information about the scientific principles underlying the preparation of a variety of products like *Khoa, Rabbri, Dahi, Lassi, Butter, Ghee, Cream* and *Channa*. The book is written in seven easy reading chapters. The first which 'deals with the composition and behaviour of milk generally' introduces the readers to an understanding of the methods described in the subsequent chapters. The last chapter is of special interest; it refers to the utilization of part of the Indian milk for the manufacture of 'Western milk products' like *butter, cheese,* and condensed and dried milks including proprietary preparations. The author, who is an acknowledged authority in this field, has advanced views on the subject of adulteration of milk and ghee, and the unsatisfactory state of legislation in the country to combat the evil. It is hoped that these views coming as they do from an experienced worker in the subject will receive the earnest attention of those concerned with the control of adulteration. To the students of dairying and allied sciences, and to the industrialist interested in the manufacture of milk products in India, the book provides an authoritative and reliable source of intensely practical information.

G. N.

"What Engineers Do". By Walter D. Binger. (Scientific Book Club, London), 1940. Pp. 150. Price 4*sh*. (postage extra).

The book under review is a brief but arresting presentation of the works of the Civil Engineer in non-technical terms both in regard to the principles involved and the structures constructed from early times to the present day. Its strong point lies in the way in which the general reader is led from the early beginnings to the most complicated structures of modern times. The book deals with civil engineering works comprising buildings, bridges, highways, railroads, tunnels, dams and waterworks of all kinds. Surveying, mapping and aerial photography also receive treatment in an interesting manner. Engineering is a branch of Science with which every one is connected in almost every walk of life, and I would recommend the book which makes fascinating reading to the general reader.

I cannot help adding that the author would be of great service to the general reader, if he can write similar books on Mechanical, Electrical and other branches of Engineering with which development of industries on modern lines is vitally connected.

K. R. S.

Health Bulletin No. 28—*Rice*. (Manager of Publications, Delhi), 1940. Pages 22. Price As. 2 or 3*d*.

This *Bulletin* is a popular summary of the important scientific conclusions contained in *The Rice Problem in India,* issued under the same auspices. Every aspect of the problem confronting the rice-eating population is dealt with in a simple, attractive manner and the price, annas two, charged for the *Bulletin* ought to place this invaluable publication within the reach of the poorest educated citizen, who ought to do a service in his turn to the wider circle of uneducated people, by informing them in easily understood vernacular all about Rice, which seems to sustain life in health when eaten without bringing it under the influence of industrial civilization, but, once under it, becomes an active agent as disease producer. Can we not preserve Rice from the baleful influences of machine civilization! Its unpolished character seems most praiseworthy.

Ramayana and Lanka—Parts I & II. By T. Paramasiva Iyer. (The Bangalore Press), 1940. Pp. lii + 152. Price Rs. 3–12–0.

Considered purely from the literary standpoint, the book is entitled to praise. The indefatigable industry of the author is worthy of the importance of the subject he has investigated.

If Brahman had conferred on Valmiki the power of visualising the treatment that the future research scholars would accord to his composition, doubtless, he would have prayed to the Creator to take away even the gift of seeing the past events, which he was ordained to record, and which has manifestly led him to trouble. This is an age of criticism, research, analysis and reasoning, and, therefore, positively dangerous to ancient classical compositions. Can not we enjoy an epic poem without its sublimity and its historical, geographical and literary blemishes

being placed on the dissection table? Criticism is a species of harmless literary recreation which provides gratification to the critic and amusement to the author, more often annoyance to the latter and embarrassment to the former.

Two learned University Professors of Sanskrit were not convinced that Mr. Paramasiva Iyer's theories about Lanka were correct but two learned ladies, however, to whom the thesis was submitted, agreed with him that "Ceylon could not be Ravana's hill-top city of Lanka". The book was written not so much because the author was piqued as because he was urged by one of his fair supporters to show her the way to Lanka; and the other Pandita would give Mr. Paramasiva Iyer no peace till he had located Lanka. That the ladies should desire to visit Lanka is just and natural, and that a cultivated gentleman should devote his time and talents to gratify that desire is equally appropriate and laudable.

To the ancients the philosophy of food consisted in freshness, flavour, colour, wholesomeness, cleanliness, texture and cooking qualities. They never bothered about calories, vitamins, minerals, and proximate principles. Taking then a broader view of food as nourishment, our ancestors did not draw any distinction between food and medicine. So it was with their literary compositions. When they wrote their epics in their mad frenzy, they forgot the rules of grammar, prosody, historical analysis, geographical accuracies and higher literary criticism; they simply abandoned themselves to their unbridled imagination. If you do not have the gift of ecstatic enjoyment, read grammar, books on prosody, literary criticism; logic, statistics, history and geography, but not Ramayana, Mahabharatha and Sri Bhagavatha.

Mr. Paramasiva Iyer has the gift of enjoyment and the gift of criticism. He has produced an excellent book, but no book carries with it universal approbation. His arguments are sound, his conclusion, correct. If statistics and maps are the field of investigation, one can prove anything. On the basis of maps, nobody could have produced a more delightful or more convincing book.

SCIENCE IN WAR

Science in War. Published as a "Penguin Special", by Penguin Books. (Harmondsworth, Middlesex, England), 1940. Pp. 140. Price 6*sh*.

NO better book could have been produced at the present moment. The book is the outcome of the collaboration of twenty-five eminent scientists, whose names are not revealed and every chapter presents a vivid picture of the relation of applied science to the urgent problems of the war. We have read the book with avidity, and we have no doubt that it would be read with equal avidity by those who are interested in science and the Great World War II. One of the fundamental points made clear in the book is that science is not something different from the problems of life either in times of peace or in times of war. When human civilization shifts from the spiritual to the technological path, it becomes obvious that the issue of international conflicts must necessarily depend upon how well and how quickly the gifts of science could be organised for the purpose of overthrowing the evil forces. It would seem that Germany has stolen marches over the rest of Europe, but Great Britain, which has always stood for orderly development of science, will make good all arrears, with her infinite resources in men and material. It will not be long before the Nazis will discover the terrible mistake they have made in provoking the Britons, whose ultimate victory will cure the Germans of all their sociological, political and economic distempers, which have been brooding over Europe till they spread with all the virulence of epidemics, and humanise them ultimately into respectability and civil behaviour. The present war is a clash in ideologies and few will doubt that Great Brtain has always espoused and fought for those ideals, which adorn her national history and her racial character. But when the enemy dehumanises his technique and methods of warfare, there is neither logic nor common sense in your proclaiming that you are reasonable and measured in directing your blows. The cause that you have set out to defend and to uphold must sanctify your means and your

weapons. There is no weapon greater than science: no means more effective than its application.

There are only eight chapters, but each chapter is packed with illuminating criticisms on the policy of neglecting the warnings which led to the tragic events and with practical suggestions for mobilising the resources which scientific researches hold for the successful prosecution of the war, and for the advancement of measures calculated to increase social services in normal times. The needs of the situation are urgent and manifold, and the capacity of science for dealing with them is obviously adequate, yet it would seem that what is actually accomplished falls far short of what could be done. The principal difficulty is that a general and organised approach to the social, economic and political problems of national welfare and existence is practically foreign to the tradition of the civil service managing the affairs of the country. Because of the chilling effects of such an atmosphere, the scientists have not shown any eagerness to see that Governments make the fullest possible use of their science. If the scientists are associated with the civil service as a matter of necessity, probably the obstacles which confront the Government in times of stress would not arise. When war breaks out, industries pass from private to government hands, and the difficulties in their management are simply accentuated, because of the difference in the attitude of scientists, businessmen and civil servants regarding the building of an effective and operative scientific service. The book is a clever exposition of the responsibilities devolving on the scientists on the one hand and the civil servants of Government on the other, and of the co-operation between them in safeguarding and advancing the interests of the country and in successfully solving those intricate national problems arising from times of trouble and travail, whether produced internally or from external sources. Attention is drawn to the serious deficiencies of scientific action in the hope that the pressure of intelligent public opinion will stimulate the power and co-operative activity of the nation in the effective utilization of science.

The second chapter bears the appropriate title "Some Things Science Had Done". Every intelligent person ought to know what is meant by "Substitutes", and how scientists have produced them; the section on "Magnetic Mines" and the "de-gaussing girdle" reads like romance. The evolution of aeroplanes, the control of infection by preventive inoculation must provide irresistible interest for even lay readers. In the succeeding chapter dealing with the contribution of science to the conduct of war, tanks and anti-tank guns have a grim interest; aerial bombardment has introduced the necessity for "Camouflage". The section on Military Morale has an arresting appeal. Chapter IV is an exposition of the achievements of medical science in the surgical department. Chapter V deals with food in all its aspects. The succeeding two chapters are equally important. The subject of the production of munitions and labour problems viewed from the standpoint of output and welfare, and the subject of the machinery of administration in handling the prodigious powers which scientific advancement has placed at the disposal of man, provide an analysis of those social and economic problems which demand the application of scientific researches to the maximum benefit of the race.

Civilization is throwing up fresh problems which can be solved only by making the fullest possible use of the scientific resources. These problems become complicated when international conflicts break out and they can be best tackled by science. This is the authoritative statement of the book.

THE CENTRAL BOARD OF IRRIGATION IN INDIA*

THE Tenth Annual Meeting of the Board was held at Delhi on 9th November 1939, and the following from the Presidential Address on this occasion will bear repetition.

> "We are now reaching a stage when the value of this body as a co-ordinating one for the results of research and experiment is becoming very apparent. Hydrodynamic experiments have been giving results which can be easily appreciated even by the layman. Diffusion of effort has been minimised by the existence of a Central Hydrodynamic and Research Station and by the opportunities given to discuss results and programmes at the meetings of this Board and the meetings of Research Officers held at Lahore and Simla. It is highly desirable that Research Officers should be in touch with field condition and for that reason, if no other, it is hoped that it will always be possible to draw a considerable proportion of the Research Officers from Irrigation Officers with an intimate knowledge of field condition."

Mr. Gorden, President, has done well in drawing our attention to this aspect of Irrigation Research. An Irrigation Research Worker may be an Irrigation Engineer with a flare for research or a scientist who has turned his attention to Irrigation Problems. But in India the remuneration which a college graduate can expect if he turns his attention to Science and Educational career is very much less than what he could expect if he turns his attention to Engineering or allied services. This is one of the reasons why an Irrigation Engineer does not want to take up Irrigation Research as his main vocation in life. Because in a field of work where Scientists and Engineers will collaborate it will not add to the efficiency of the work if they are placed in two glaringly different water-tight compartments.

In this connection the following remark of Mr. Gorden is very pertinent.

> "I hope I am wrong, but my opinion is that the new services which are being introduced are not likely to attract the type of man, who is required."

In the new services attempt has been made to make Engineering and Educational services equally attractive. This of course will not attract right type of man for the Engineering services from outside India; but Indian Technical colleges produce now-a-days enough men of this type to man all such services.

Mr. Gorden, however, is evidently nervous about these changes. He says, "We are living in a period of transition, when the officers who have built up India's irrigation systems are being replaced by Indians who have a different upbringing and have not the same opportunity for being in touch with practical engineering from an early age. Their task will be a difficult one, particularly in the early stages, but with the help and guidance of the officers at present in service, it is to be hoped that a standard of efficiency will be maintained which will prevent any deterioration in our irrigation system".

This statement is not correct at least for irrigation services. When an engineer from England used to be appointed to this service his acquaintance with the practical aspect of this line was as poor as that of an Indian Engineer from Roorke or Sibpur. In spite of that they have succeeded and it is hoped that Indian Engineers will improve upon their record.

Reports from the following five Research Stations have been given in abstract.

1. The Central Irrigation and Hydrodynamic Research Station, Poona.
2. Punjab Irrigation Research Institute.
3. Development and Research Division, Sind.
4. Poona Irrigation and Research Division.
5. United Provinces P.W.D. (Irrigation) Research Section.

Of these, Development and Research Division, Sind and United Provinces P.W.D. (Irrigation) Research Section are comparatively new and their activities are also limited. In model experiments they have been mostly confined to sectional models though Sind had been trying rigid geometrically similar three-dimensional models. They claim that their model results so far as silt distributions are concerned are faithfully reproduced in the prototype. This is an aspect of the problem that requires careful and exhaustive examination.

When the Government of India undertook to finance the Central Irrigation and Hydro-

* *The Annual Report of the Central Board of Irrigation, India*, 1938–39. (Manager of Publications, Delhi), 1940, Pp. iii+185.

dynamic Research Station, Poona Irrigation and Research Division was created and taken up by the Bombay Government. This station deals with all irrigation problems that do not concern hydraulics. Most of the research work done by this Division is very closely related with agricultural subjects.

Work of the Central Irrigation and Hydrodynamic Research Station, Poona, has considerably increased during the year under review. Demand for model experiments are increasing as engineers are coming to realise that model results can be relied upon. Simple model experiments such as for scour below falls, can be carried out successfully in stations with moderate equipment. The technique for such experiments have developed to such an extent that in bigger hydraulic laboratories they are undertaken as routine work. It is only when more complicated experiments such as those of river training or silt exclusion at headworks are concerned that the usefulness of the Central Station is felt. Besides the Punjab Irrigation Research Institute, this is the only Research Station in India which is dealing with such complicated problems. The science of such model experiments is as yet very imperfectly understood. It will require years of patient study to make it an exact science. Of course, as it is it can give very valuable indication of what is going to happen in the course of a river if certain conditions are fulfilled; but the technique of such experiments is so complicated that only experienced research workers should undertake them. A case in point is the Punjab Irrigation Research Institute experiments with spurs. Mr. Thomas of the Central Irrigation and Hydrodynamic Research Station, suggested in this connection (p. 17) "that the results obtained, though of great interest and particular application in the case concerned are not of general application unless discharge is considered as a factor. The placing of spurs must depend on the natural meander length of the channel which is approximately as $\sqrt{Q}$. Thus the flow lines shown in the photos differ in the case of $l = 700$; $d = 2{,}000$ from that of $l = 500$; $d = 1{,}500$, though the d/l ratio is nearly equal".

Among the "Basic Experiments" given in the report of the Central Station there is the mention of a hot air anemometer to detect turbulence. This instrument had been used in water previously by English and German Scientists with no great success. It will be of great scientific interest to know the details of this instrument if it is working satisfactorily at the Poona station.

The Punjab Irrigation Research Institute deals with all problems that touch even the fringe of Irrigation. On page 13 of the Annual Report we find:

"An investigation which is of considerable importance in connection with the interpretation of well records concerns the negative pressures developed in water films surrounding soil particles. It has been shown that wells are probably acting as manometers. In the field the greatest negative pressures are developed during the hot weather. The rainfall during the monsoon period flattens the concave minisci of the water films thus reducing the pressure deficiency. As a result the water in the well shows a considerable rise which is out of all proportion for the rainfall received. The rise in well levels during the monsoon period does not therefore represent addition of water to the watertable."

This seems to question the validity of all well records specially after a spell of dry weather. It will be interesting to know if these observations have been confirmed at other places and if they do not depend on the nature of soil crusts.

On going through this interesting Annual Report one is struck by the fact that there is practically no mention of Bengal, Bihar, Orissa or Assam. It appears as if these provinces have no irrigation or river problems. Neither have they any Research Station of their own nor do they refer anything to the Central Station. People often wonder how provinces like the Punjab or Sind spend so much on irrigation research while provinces like Bengal do not spend even a single farthing on river research. It is because the Punjab Government finds that every rupee spent on irrigation research brings more than its full value in return while the Bengal Government knows full well that money spent on river research might bring prosperity to the country-side but it will not add directly to the Irrigation Revenue. It is this difference in the return value of the money that makes the two Governments act so differently. In the United States of America however lakhs of rupees are spent every year for river research because there millions of dollars worth of private properties are involved in a flood such as that of the river Mississippi or Ohio.

THE MARKETING OF COFFEE IN INDIA

AMONG the many lines along which the problem of low prices of coffee is being attempted to be solved by the Indian Coffee Cess Committee is a survey of the present marketing conditions of coffee so that the scope for practical action in this all-important branch of the industry may be determined on reliable and accurate data. The survey has been conducted as part of the marketing surveys of the Agricultural Marketing Officer of the Government of India and the result is now published as *Bulletin* No. 21—*Marketing Series*. As about one-third of the coffee produced in India is exported abroad the survey gives relevant particulars regarding the marketing methods in these foreign markets also. The survey relates also to Burma, although the industry there is a very small one and Burma is in any case no longer in the picture as an Indian province.

The area under coffee in India is estimated at a little over two lacs of acres and the production about 5·8 lacs of cwt., valued at about 1½ crores of rupees. The import of raw coffee is forbidden and this embargo acts as an efficient measure of protection. The export market absorbs the best grades and its value is nearly a crore of rupees or about two-thirds of value of the total crop though the quantity is only one-third. The core and centre in the situation is the extraordinarily low *per capita* consumption in India and the fact that even this is confined to some of the South Indian districts leaving the rest of this province and practically the whole of Upper India untouched by the coffee habit. The *per capita* consumption for the whole of India is only about 0·13 lb.; the Report rightly says if this could be increased by even so small a quantity as 0·15 lb. per head the entire coffee produced in India could be easily absorbed in this country itself. The development of the home market is indeed the most promising line of action and there is much useful information in the survey which indicates what practical steps can be taken towards this end. We refer especially to the development of the trade in ground coffee and even some of the manufactured products, not to mention the excellent propaganda of the Committee which is already proving successful. A guarantee of purity such as the AGMARK standards imply should be a primary requisite and one may hope that the legislation against adulteration passed in recent years in all the provinces will have the desired effect and ensure this important requisite. About 70 per cent. of the packages sold as "pure coffee" were found to be adulterated, to degrees ranging from 0 to 68·5 per cent. and most of them were found unfit to be sold as coffee at all. No wonder this is the greatest impediment to the expansion of the sale of coffee! The Report describes in great detail the packing methods in vogue including the CO_2 inert gas pack which ensures the best method of preventing oxidation and rancidity. The growing tendency even for the housewives of South Indian homes to prefer the ease of the tinned powder to the trouble and nuisance of roasting and grinding at home deserves to be taken note of.

The marketing conditions themselves present as unsatisfactory features as can be met with in any other agricultural product in this country notwithstanding the fact that the coffee industry is largely in the hands of a far better class of people than the ordinary cultivator. Statistics of acreage and production are both hopelessly inaccurate, the difference between the published and correctly estimated figures being over 35 per cent. Market grades are far from standardised; a case is quoted of two curers classifying one and the same lot of coffee exactly reverse of one another! Estates and standing crops are largely mortgaged and interest charges vary from 7 to 25 per cent. Marketing charges on hypothecated crops (including interest) are said to be double those on non-hypothecated crops. The margin between wholesale prices and the grower's share is excessively large, the latter ranging from 55 to 66 per cent. of the former. Mixing of grades, colouring of the beans and similar malpractices also exist; the report offers suggestions to improve matters and secure for the grower a better share of the price. Growers' organisations for effecting direct sale have been few and even those were failures. One hopes that the newly formed Coffee Curing Company in Chickmagalur will afford material relief in this direction and really benefit the grower.

Considerable attention has been devoted to the subject of improvements in the preparation of "parchment" and "cherry" and the suggestion is made that growers should be helped to produce more of the former as the returns on "parchment" are much higher. Mention is made of the efforts made to improve coffee intended for the English market by making it approximate *Costa Rica* in appearance and the writer remembers reading with not a little disappointment at that time that the London market would prefer Indian coffee in its natural imperfection clad in its silver skin. Much space is also devoted to the question of "quality", especially for the London market and despite commendable scientific work, specific gravity and the liquoring test hold the field. It may perhaps be worthwhile to employ temporarily a taster to help in selecting coffees intended for the London market; the matter deserves consideration by the Committee at least as an experiment.

The Report deals with the whole question of marketing in the comprehensive manner which we have learnt to associate with these marketing surveys, and is full not only of information on the various aspects of the industry but also of valuable suggestions for effecting improvements. We congratulate the Indian Coffee Cess Committee on its commendable enterprise in initiating this survey and the Marketing Officer on the care and thoroughness with which the work has been done.

A. K. Y.

CENTENARIES

Carlisle, Anthony (1768–1840)

SIR ANTHONY CARLISLE, a distinguished British surgeon, was born near Durham in 1768. The early part of his medical education was at Durham under Mr. Green, founder of the hospital of that town. He completed his education under Mr. Watson of the Westminster Hospital where he succeeded him as surgeon in 1793. He continued in that post till his death. From 1808 he also held the post of professor of anatomy to the Royal Academy.

Carlisle was a good surgeon. His introduction of the thin-bladed, straight-edged amputating knife, in place of the old clumsy crooked one, and his use of the simple carpenter's saw make his name worthy of note. The number of papers he contributed after 1800 were 17. The last one entitled *Some observations tending to demonstrate the dependence of vascular organisation upon physical causes* appeared in the *Reports* of the Guy's Hospital of 1840, the year of his death. In 1804 and 1805 he delivered the Croonian lectures on *Muscular motion* and *Muscles of fishes* respectively.

Carlisle contributed to other fields of knowledge also. For example, in 1800 he collaborated with W. Nicholson in his researches on voltaic electricity and is credited to be the first in observing the decomposition of water by the electric current.

The chief of his published books are *An essay on the disasters of old age, and on the means of prolonging human life* (1817); *Alleged discovery of the use of the spleen* (1829); and *Physiological observations upon glandular structures* (1834).

Carlisle was very early elected on the Council of the College of Surgeons. In 1800 he was elected a fellow of the Royal Society. He was surgeon to George IV, when he was prince regent, who conferred knighthood on him at the first levee he held after he became king.

Carlisle died at his house in Langham Place November 2, 1840.

Brashear, John Alfred (1840–1920)

JOHN ALFRED BRASHEAR, an American instrument maker, was born of a saddler at Brownsville, Pa, November 24, 1840. His maternal grandfather who had a passion for astronomy taught the boy the constellations by the time he was eight; he also presented him in 1850 with a set of Dick's *Works* and paid for a first view of the heavens through a telescope. About this Brashear wrote later: "Young as I was, the scenery of the moon and the rings of Saturn impressed me deeply". From 1856 to 1881 he was engaged in various pieces of hard work. But the memory of the beauty of the first vision of the heavens persisted so much that he decided to make a telescope for himself as he was too poor to buy one.

He knew nothing about the polishing of lenses, but he brought a glass for a five-inch lens and some books on the grinding of lenses. After toiling in the factory throughout the day Brashear would spend long hours in the night in polishing the glass. This he did for three full years and at last he realised his ambition. From this modest beginning he rose to become the peer of any maker of astronomical and other instruments of precision.

This telescope he made for himself brought him into touch with astronomers and in 1881 he set up independent business as maker of astronomical instruments. It is impossible to estimate accurately the progress in astronomy due to his mechanical genius. To-day his glasses are still in use in most of the observatories of the world.

Brashear's mastery of the art of making a plane surface was marvellous. The speculum metal plates from which the famous Rowland Diffraction Gratings were made required a very accurate surface. The error had to be less than one-fifth of a light wave or one two-hundred-thousandth of an inch. Surfaces of such evenness were produced by Brashear.

Another great contribution to science is the Brashear Method of silvering mirrors, which was of immense use in the design and development of the spectroscope.

His personality even overshadowed his mechanical genius. To literally thousands of people he was known familiarly as "Uncle John". The force that dominated him was a sincere desire to share the beauty of the universe with all mankind. He was one of the three men selected by Andrew Carnegie to draw up plans for the Carnegie Institute of Technology. When Henry C. Frick decided to make his gift of half a million dollars to establish the Frick Educational Commission, he stipulated that Brashear should direct the organisation. Such was his geniality and the confidence that his conduct had induced in others.

Brashear died April 8, 1920.

University Library,
Madras. S. R. RANGANATHAN.

CONTROL OF LANTANA THROUGH INSECTS*

THE insect enemies of Lantana are numerous, though considerably varying in their relative importance as being destructive agents. The question of the actual extermination of the weed by the use of certain of its more effective insect enemies, is a very old one, having been thoroughly examined long ago principally in Hawaiian islands, in Fiji and Australia. The peculiar geographical positions of Hawaii and Australia and Fiji, apart from other factors, rendered the importation of efficient insect enemies from Mexico and their establishment in those islands very successful, with the result that the spread of lantana there was greatly checked. Complete extermination, of the weed, has, however, never been claimed even in these countries.

In India a serious beginning in the matter of investigating the possibilities of checking the spread of the weed was made in 1916. An exhaustive survey of the indigenous enemies of lantana was made. No definite action was, however taken, presumably because, no particular insect enemy appeared to be of any considerable importance in successfully checking lantana, and the then Imperial Entomologist was thoroughly against the importation of new insects from outside.

In 1921, however, the well-known lantana seed-fly (*Ophiomyia lantanæ* Fg.) was imported from Hawaii into Mysore and a few flies successfully emerged out; but attempts to breed them in numbers was not successful; later attempts did not meet with any better success either. No further notice was taken and it was believed that the few flies in question soon died out. But in 1932 it was found that the fly could be reared out of ripe lantana berries not only in Mysore but in various parts of India and even Burma, in spite of the fact that the presence of the fly in India had not been made out in the original survey in 1916. Although the incidence of the fly in the different areas was negligible, the very presence of the fly was thought significant. Whether the fly has all along been a native insect of little importance or whether it has really spread out to distant areas in India and Burma from the small original introduction into Mysore in 1921, is a disputable point. In any case, the seed-fly is not likely to be of any value in checking lantana.

The authors of this volume have thoroughly re-examined the question from all aspects and come to the conclusion that, as matters stand at present, there is "little hope of finding an insect in India that is sufficiently manageable to be used as and when required for local destruction of lantana and that a resurvey of insect fauna of lantana in its original home Mexico is inescapable, if complete control of the weed is required, in India". It appears improbable that lantana can, at any time be economically and successfully exterminated, unless by means of a suitable insect enemy —perhaps foreign as in the case of cactus in S. India.

* "Possibilities of Control of Lantana by Indigenous Insect Pests" by C. F. C. Beeson and N. C. Chatterjee, *Indian Forest Records*, Vol. 6, No. 3. (Manager of Publications, Delhi), 1940. Pp. 41–84. Price Re. 1-4-0 or 2*s*.

SCIENCE NOTES AND NEWS

Excavations at Lauriya Nandangarh.—*Original Manuscripts Discovered*: In the extreme North of the Province of Bihar is Lauriya Nandangarh in the District of Champaran, well-known for the presence of a pillar of the Emperor Asoka, in almost complete preservation marking one of the sites of the pious king's visit from his capital near Patna to the birth-place of Buddha. The name Lauriya strictly applies to the village near the 'laur' or 'pillar', the neighbourhood of which is dotted by a number of mounds, which were some time ago examined by the Archæological Department.

Nandangarh is the name of a large *garh* or fort, lying at some distance from Lauriya and thickly covered with jungle. This has been regularly excavated by the Department during the last five years and has brought to light a stupendous monument unequalled for its size and the earliest prototype of the architecture of the Burmese and Malayan stupas and the well-known Borabudur monuments in Java. The plan of the monument is a huge square cross with a number of projections in between the arms of the cross, and, as in the great temple at Paharpur, there are also several terraces rising one above the other, although the evidence of the finds shows Paharpur to be much later in date than the Nandangarh mound.

A Buddhist Monument. The religious character of the monument at Nandangarh was not clear till the excavations conducted recently brought to light certain finds in the centre of the mound. On the assumption that the monument must have been erected by the Buddhists a shaft was dug in the centre and at a depth of some 36 feet from the top a complete stupa, which was planned as a miniature of the exterior of the monument, was uncovered. This was surrounded on all sides by a low platform at the foot of which was found a copper casket containing a strip of white muslin with fragments of a birch-bark manuscript and small pieces of wood and carnelian beads. As the manuscript had been forced into the casket, it was found impossible to open the individual leaves without breaking. These have been found to contain certain Buddhist texts written in characters of the 3rd-4th century A.D. It appears that the original monument was several centuries earlier than the casket and the manuscript with which it was apparently reconsecrated at a later date.

The present find is, on the whole, the only

one from Eastern India wherein an original manuscript has been recovered, all such discoveries having so far been confined to the North-West of India.

New Calcite Source Discovered.—Messrs. Bausch & Lomb Optical Co., Rochester, N.Y., have announced the discovery of a new source of calcite, or Iceland spar, a valuable optical mineral heretofore imported from abroad; the Company have contracted for the output of a new mine in the San Padro mountains, north-west of Santa Fe, New Mexico.

The discovery by a Mexican prospector of the new source of supply and the interest of E. M. Stanton, a Chicago optometrist, led to a subsidy by Bausch & Lomb through which operations have been carried on.

The scarcity of optical calcite has caused a world-wide search for many years, since the mineral is essential in the construction of all polarizing instruments. With the flooding of the Iceland mine at Helgustadir during the World War, this source which formerly supplied the world has been unproductive for fine crystals. Meager supplies have come from various countries, the most recent from Spain and South Africa, but the total quantity offered for sale has been insignificant for many years.

Officials reported that the new mine had delivered more than five hundred pounds of fine calcite crystals within a period of three months, many of them weighing as high as 40 pounds. An analysis of the output of the new mine indicates that the United States now has a supply of calcite of high optical quality which will serve the country for years.

The physical properties of the mineral must be carefully considered in mining and handling the crystals. One is its perfect rhombohedral form. One misdirected blow may cause incipient fracture throughout the whole crystal and ruin it for optical use. Crystals, or cleavage fragments, less than one inch long and a half inch thick are rarely usable. Each piece must be colourless, absolutely transparent and completely free of inclusions, cavities, or foreign particles.

The most important use of Iceland spar is for the manufacture of Nicol prims, essential optical parts of polarizing microscopes, saccharimeters, colorimeters, polariscopes, and many other instruments vital to research and technology. This type of prism was designed by William Nicol, a Fellow of the Royal Society of Edinburgh, in 1828.

The Imperial Institute of Sugar Technology, Cawnpore.—The Gangetic Valley appears to be the birthplace of sugarcane and although India was well acquainted with its cultivation and methods of preparation of gur and sugar from ancient times, still the consumption of these products seems comparatively less in their home than in Europe and North America. The place of sugar or gur in the Indian diet is partly taken by rice. Within recent years, however, India has developed a marvellous taste for refined sugar and the industry has grown proportionately, favoured by protection and applied science. Cawnpore, sandwiched between two of the noblest rivers, is admirably suited for stationing the Imperial Institute of Sugar Technology, which was created in 1936, on the recommendations of the Sugar Committee and the Tariff Board, from out of the Sugar Section, maintained at the Harcourt Butler Technological Institute. Equipped with all the facilities necessary for undertaking advanced researches in pure and applied branches of sugar chemistry, the Institute has also been serving the needs of the industry in its technical, commercial and statistical aspects. The Institute has accepted the responsibility for the collection, tabulation and analysis of scientific control returns from factories and for making the results of detailed study of these returns available to factories in the form of technical and statistical reports. It is practically the official expositor in India of the latest developments in the sugar industry abroad which, in their application to indigenous problems, are carefully examined in the light of the local conditions. To undertake and successfully to carry out work in all these important departments, the Institute is provided with a competent and enthusiastic band of young scientists, who within the short period of the existence of the Institute have rendered remarkable service.

Preliminary Annual Report of the Public Health Commissioner with the Government of India for 1939.—The publication of the Annual Report of the Public Health Commissioner is necessarily delayed and a brief review of the health conditions in India is welcome. At the same time the growing demand for an early presentation to the public of the picture of changing health conditions from year to year cannot be ignored. The year 1939 was comparatively free from violent outbreaks of epidemic diseases. The campaign for improved health can be maintained and extended only with the co-operation of the people and an informed public opinion constitutes the basis for such co-operation. Few realise that disease is war and health is resistance. The problem of public health therefore like the problem of war is essentially an economic problem. Given a continuous and adequate supply of proper food at a cheap rate to the poor people, pure water, fresh air, decently ventilated houses, efficient and strict supervision of public eating houses, mitigation of road dust and protection of streets from stray animals, a reasonable sanitary sense on the part of the people and municipal vigilance over the drains and disposal of waste, public health may not cause periodic anxiety. Theoretically we admit that they constitute a stronger fortification for the safety of the people than a Maginot Line. On which are we prepared to spend more money?

The Punjab Fruit Journal.—The 1940 number of this Journal is a sumptuous edition, maintaining the high standard of excellence which has characterised its predecessors. There is hardly any branch of Fruit Industry on which there is not an interesting article contributed by an expert scientist, and in its totality the Journal is manifestly encyclopædic in its information. The Chief Editor, Mr. S. S. Lal Singh, deserves unstinted congratulations and his zeal and devotion in disseminating

knowledge about fruit, in its scientific, industrial, economic and physiological aspects,—in English and Urdu,—have secured the close and cordial co-operation of a distinguished band of enthusiastic writers. This is a branch of occupation meant not only for the villagers, but essentially for the educated young men who will find in it, the widest scope for their activity. We have no hesitation that the superlative importance of the subject will secure for the Journal the widest reception and for the organisers the grateful appreciation and encouragement of the agricultural authorities and the educated public, whose active interest it is the object of the Journal to secure and increasingly to sustain.

Annual Report of the Imperial Dairy Expert for the year ending June 1939. (Manager of Publications, Delhi. Pp. 35. Rs. 1–6–0 or 2*sh.*) This report describes the educational, research and commercial activities of the Imperial Dairy Institute and its farms for the year ending June 1939. This year's report has been written on a different plan with the result that it is shorter, and much repetition of material has been avoided.

Sixty-five students received training in dairying and dairy husbandry at the Institute during the year, including 23 diploma, 16 post-graduate (2 batches) and 22 short-course students. Out of 26 candidates for the Indian Dairy Diploma, from the Allahabad Agricultural Institute, 21 were successful.

Research work carried on from previous years and described in previous reports has been continued. Much of this work is long range in nature, such as breeding of dairy cattle, breed improvement, investigations on fertility and heredity, testing of bulls and the defining of milking performance. A description of some of this long range work would be acceptable in the report. There is no doubt that a great deal of data has been collected during the past few years which with proper treatment would supply useful information.

It is suggested that a drawback in this and in previous reports is the lack of description of the results of research work in the text. Every year the work on hand is described but there is very little attention given to the publication of the results or of opinions reached as the result of investigation.

Work on feeding cows on molasses soaked into bagasse shows that this by-product of the sugar industry can be fed up to 10 lb. per head per day, and can replace 3 lb. of concentrates.

The investigations on milk and its by-products comprise bacteriological and chemical examinations of milk, the manufacture of butter, ghee, dahi and khoa. The renneting properties of extracts of the fruits of *Withania coagulans* and the properties of the cheese so made have been studied and have given results worthy of future elaboration. Various pieces of machinery and equipment have been tried out for efficiency.

The profitable commercial activities of the Institute and its farms are the best evidence of the practical training given to the students. The total expenditure reported is Rs. 2·06 lakhs and the receipts Rs. 1·12 lakhs (54 per cent.). The nett expenditure on dairy education for the year cited was thus Rs. 0·94 lakhs. W.L.D.

Indian Institute of Science. The thirty-first Annual Report of the Council of the Indian Institute of Science is an interesting document; and the fact that there has been a notable absence of all reference to the affairs of the Institute in the public press affords evidence that it is now devoting its energy and resources to the prosecution of its legitimate functions. Dr. J. C. Ghosh, D.Sc., F.N.I., assumed charge of the duties of the Director on 1st August 1939. The total income for the year covered by the Report amounted to Rs. 5,14,080. The expenditure for the same period was estimated at Rs. 5,66,120, but the actual expenditure was, however, only Rs. 5,07,171; decrease was due to savings from items for which provision was made in the budget. In respect of the members of the staff, mention may be made that Dr. P. C. Guha, D.Sc., continued to act as the Head of the Department of Pure and Applied Chemistry. Messrs. B. N. Banerjee and M. Sreenivasaya were in charge of the Department of Biochemistry during the absence of Dr. V. Subrahmanyan on foreign deputation. Dr. H. J. Bhabha of the University of Cambridge was appointed Special Reader in Physics for delivering a course of 25 lectures on Cosmic Rays and Prof. R. A. Millikan gave four lectures on "Experimental Methods and Results of Cosmic Ray Research". Mr. K. Amrita Rao retired from service and his place as Librarian has been taken by Dr. G. T. Kale, D.Sc. The Council have made provision for implementing the recommendations of the Court in respect of instituting researches into industrial problems. The total number of students and other workers during the year under review was 194. Part II of the Report gives a brief descriptive account of the important pieces of research work done in the Scientific Departments together with a list of Scientific Publications.

Report of Indian Lac Cess Committee Research work carried out at the Indian Lac Research Institute and the London Shellac Research Bureau during the year 1939-40 has shown considerable progress; during the period emphasis has been laid on the practical application of the results of experiments.

The outbreak of war stimulated a rapid development of the activities of the London Bureau owing to the demands of the Defence Departments for various types of luminous and black-out paints, coating composition for anti-gas clothing, a quick-setting cement for metals, a flexible and grease-proof coating for rubber surfaces, a quick-drying oil-resistant paint for metals, and a quick-drying sea-water-resistant paint.

Experiments in the Indian Lac Research Institute for the production of modified shellac powders for the moulding industry are in rapid progress, as the use of these powders in the making of electro-technical goods and a variety of common household articles, opens up a considerable field for new industries. Further work has been carried out and practical details formulated for the manufacture of the plastic moulded articles, motor car finishes and stoving enamels from shellac. A number of experiments have been designed to minimise the use of imported materials in the processing of shellac for these new industries.

Lac has now been brought under the operation of the Agricultural Produce (Marking and Grading) Act of 1937 and tentative specifications framed for seed-lac have been circulated to the trade interests concerned for opinion. During the year under review exports of lac registered a 20 per cent. increase over the previous year. Production fell from 1,465,000 maunds in 1938-39 to 1,394,000 maunds. At the outbreak of war, prices soared, but after passing through a period of fluctuation had reached a more or less steady level at the end of the year. From Rs. 13 per maund in April 1939 prices touched Rs. 40 in December 1939, and at the end of the year under review stood at round about Rs. 30.

Agricultural Marketing in India (Report on the Marketing of Eggs in India and Burma).—This report is of inestimable value to schools, agricultural and veterinary colleges and other institutions connected with the activities of developing the cottage industries and rural regeneration. Its importance to the administrators and statesmen is no less profound. The subject of rearing fowls and other birds whose eggs are consumed is generally regarded as a branch of agriculture, but we consider that it is perhaps the most important major industry, probably taking precedence over munition factories, which regulates and sustains the health of the whole population, besides providing relief to the pressure of unemployment. A nation that tends its cows, fowls and bees with respect and tenderness is better employed than another engaged in making spitfires, U-boats and tanks. The aggregate cost of eggs marketed in a year amounts to 5·25 crores of rupees, and the value of the birds which produce them equals about 7·5 crores. The report points out that by sheer neglect, about 14 lakhs of rupees worth of eggs are simply not collected in the course of the year. Poultry farming is now in the hands of ignorant and incompetent people in the villages, and if young educated men should take to it and apply their scientific knowledge and training to the problems, the country will have better eggs, better chicken, better health and better spirit.

Marketing of Indian Coffee.—The Agricultural Marketing Adviser to the Government of India in his report on the Marketing of coffee in India and Burma, invites attention to the fact that the import of coffee into the United States has nearly doubled. From 7,657,000 cwt. in 1909-13 it has risen to 15,320,000 cwt. in 1937. The average annual consumption per head has also increased to nearly one and a half times during that period, from 9·6 lb. in 1910-14 to 13·3 lb. in 1937, which points to the ever increasing popularity of the beverage in the United States.

Although more than half the coffee exported from Brazil is taken by the United States of America, "mild" coffee has steadily made headway against "Brazilians" during the last ten years. The imports from British East Africa rose from 3,000 cwt. in 1927 to 135,000 cwt. in 1935, and to 257,000 cwt. in 1936. The East African and Indian coffees come under the same "mild" category; and whereas the East African coffees have taken big strides in the course of a few years, it is regrettable that Indian exports to the United States of America, are negligible.

According to the Agricultural Marketing Adviser, this is entirely due to the absence in Indian coffees of those standard grades which are necessary as a basis for large-scale sales. Differences in commercial descriptions and variations in the size of beans between the contents of different bags are apt to hamper expansion of the market for Indian coffee. It appears that one consignment of 500 bags of Indian coffee imported into the United States of America included 87 different marks, each of which had to be sampled separately and tested by a taster. This makes business difficult in a country where standardised products are essential for the large multiple shops and chain stores.

To stimulate the demand for Indian coffee, both at home and abroad, the Agricultural Marketing Adviser urges the need for the improvement and systematization of existing methods of classification and grading of coffee and strict supervision and control of operation of the rules enforcing the grade standards. We earnestly hope that these recommendations will be immediately accepted, and an ever expanding market for Indian coffee secured abroad.

We wish to invite the attention of those interested to an exceedingly informative and illustrated article on **The Tung Oil Industry of the Unitd States** by M. Ashby, Ph.D., of the Imperial Institute. The article (*Bull. Imp. Inst.*, 1940, 38, No. 1) represents the report of an inquiry carried out in Florida, Louisiana, and Mississipi, at the suggestion of Sir Frank Stockdale, K.C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies. Information relating to the region of cultivation, the species, soil conditions, climate and topography, cultivation practices, yields, diseases, pests and physiological troubles, treatment and exploitation of fruits and the trade aspects of the tung oil industry, are all discussed in the article.

Indian Apple Juice.—We wish to invite the attention of those interested to Bulletin No. 39 of the Imperial Council of Agricultural Research (price As. 14), which describes a simple and economical method of preparing unfermented apple juice. This is a pleasant non-alcoholic drink for which there is already a small demand in India. The cost of production on an experimental scale worked out to seven annas per 24 oz. bottle, which compares very favourably with the price of imported apple juice.

Dried Blood for Transfusion.—To combat shock through loss of blood, blood transfusion is largely used in modern medicine. Such blood is difficult to obtain in quantity for the treatment of the wounded in the field and other methods are being carefully considered. One of the most successful and promising of these methods is the use of dried blood plasma. Blood to which Sodium Citrate has been added to

prevent coagulation is allowed to settle and the clear liquid drained off. This liquid is dried *in vacuo* to a granular powder and packed aseptically in containers. Before use it is made into a solution with sterile water and given to the patient in the same manner as a blood transfusion. A sample of dried Blood Plasma, the first to be made in India, was shown to the Medical Stores Supply Committee, which discussed the question of its manufacture in India.

Fish Liver Oils from Indian Sources.—Much progress has recently been made in Travancore, Bombay and Madras in the development of fish liver oil schemes for supplying India with substitutes for Cod Liver Oil. The essential factor in these oils is their content of Vitamin A and Vitamin D. As the shark liver oil has ten times the Vitamin A content of Cod Liver Oil it forms a valuable source of Vitamin A. This oil, however, is lacking in Vitamin D so that it is necessary to add this vitamin to it. Vitamin D, a complex chemical substance has, now for the first time, been made in India at the Indian Institute of Science.

Thanks to the munificence of the Trustees of the Sir Dorabjee Tata Charities, it has now become possible to instal a Cyclotron in the Calcutta University for enabling research on atomic structure. According to a report from the **Associated Special Service**, a sum of Rs. 60,000 has been granted to the Calcutta University by the Trustees of Sir Dorabjee Tata Charities on condition that a like amount is made available by the University. The Cyclotron will weigh 70 tons and is expected to cost Rs. 120,000. The research will be directed by Prof. M. N. Saha.

The Currie Scholarship.—The President of the Forest Research Institute, Dehra Dun, has favoured us with the following note on the history of the Currie Scholarship for Indian Forest Students. This scholarship originated in July 1887, when, on the occasion of the Distribution of Prizes at the Cooper's Hill College, Mr. B. W. Currie, who was then Vice-President of the Council of India, made a personal gift of £1,000 of 3½% India Stock in response to a plea by the President of the College for an increase in the number of scholarships available to its students. Mr. Currie left it to the President and Members of the Council of the College to determine the manner in which his gift should be applied, but expressed the hope that the scholarship to be derived from it would be made retrospective to the year 1887.

In October 1887, the Board of the College decided that the endowment founded by Mr. Currie, which had then with his approval been designated the "Vice-President's Scholarship", should be appropriated to providing one or more scholarships in Applied Mechanics, the President of the College agreeing that his own scholarship of £20, which had hitherto been given to Applied Mechanics, should be transferred to Forestry. This arrangement continued until 1892, when owing to the disappearance of certain mathematical scholarships a redistribution of the available scholarships became necessary, and it was decided to assign one part of the Vice-President's scholarship to Applied Mechanics, and the other part to Forestry, and to transfer the President's scholarship to Mathematics.

In 1906 when the College was closed down, and the question arose of what was to happen to its scholarship funds, Professor Schlich represented that Mr. Currie's intention had been to found a scholarship for Forest students, and that the appropriate thing to do would be to give his scholarship to probationers undergoing training for appointment to the Indian Forest Service. This view of Mr. Currie's intention was contested by the President of the College, who was of the opinion that the endowment should be returned to Mr. Currie's heirs, but the Legal Adviser held that such a proceeding would not be proper and after consultation with Mr. L. Currie, it was ultimately decided that the scholarship should be awarded to the probationer who headed the list at the final examination prior to appointment to the I.F.S. The Scheme of 1908 was accordingly drawn up and the scholarship was awarded under it until 1927, when the practice of training I.F.S. recruits in this country on probation came to an end.

The Central Committee of the Anti-Tuberculosis Challenge Shield. A Central Committee meeting of the Tuberculosis Association of India was held at the Viceroy's House, New Delhi, on the 28th October, under the presidency of H.E. the Marchioness of Linlithgow. Besides some routine matters, the following business was transacted. The Committee approved the award of the Hassan Masud Suhrawardy Memorial Anti-Tuberculosis Challenge Shield for the all-round good work on tuberculosis done during 1939 to the Madura Municipality which competed among 12 others. It was decided to request affiliated Tuberculosis Associations to send half-yearly (quarterly if possible) reports of their activities for incorporation in the tuberculosis news service of the Central Association. The Committee also decided to proceed with the election of five members to the Central Committee from the affiliated Associations. Finally, the Committee resolved to offer to Dr. C. Frimodt-Moller, C.B.E. (Hon.), the present Medical Commissioner of the Association, an extension of appointment by two years on the expiry of his present contract on the 30th April, 1941.

Tuberculosis Clinics.—That if a tuberculosis clinic is to be of maximum benefit, it should be situated in, or as close as possible to, a thickly populated area, is the unanimous opinion of the Committee of experts recently appointed by the Tuberculosis Association of India at the instance of the Government of India, to consider what conditions should govern the selection of sites for such clinics and whether any particular precautions were necessary in the case of clinics situated in populated areas.

The Committee were also of the view that no particular conditions are necessary regarding the distance of a well-conducted clinic from

the nearest house. They recommended, however, that if a clinic is located in a part of a building used for other purposes, the clinic should have a separate entrance.

Indian Coal Industry.—In his Presidential Address before the Sixteenth Annual General Meeting of the Geological, Mining, and Metallurgical Society of India, held on 27th August 1940, Mr. H. K. Nag dealt with the Indian Coal Industry as it exists to-day. After referring to the action taken by the Government of India on the recommendations of the Coal Mining Committee of 1937, Mr. Nag suggests the following measures for the stabilisation and development of the Coal Industry: (*i*) Control and adjustment of output in order to obtain reasonable prices, (*ii*) organisation of marketing the product, (*iii*) better wages and amenities to employees, (*iv*) comprehensive researches on coal in all its phases, low temperature carbonisation and hydrogenation, for proper utilisation of coal, (*v*) rationalisation with an eye to efficiency and avoidance of waste, (*vi*) education of labour for safety and efficiency, and (*vii*) attention to more efficient and scientific methods of mining. He has also suggested the desirability of having a well-thought-out and comprehensive scheme for the formation of a Joint-Stock Company including representatives of all the main coal trade organisations in India and proceeds to point out how such a body can effectively work for the future well-being of the industry.

We have been informed from the Principal, Fergusson College, Poona, that a large collection of reprints, bulletins, memoirs, etc., on **Mycology and Plant Pathology** has recently been presented by Dr. B. B. Mundkur of the Imperial Agricultural Research Institute, Delhi, to the Fergusson College. The collection consists of about 5,250 publications besides complete sets of "Mycology" and "Phytopathology", and several books on these subjects.

Dr. Mundkur started collecting reprints in 1924 and requests from him for reprints must have been received by every mycologist and plant pathologist in all countries where the study of these subjects has made any progress. Reprints of articles by Hemmings, Magnus, Dietel and others were purchased from the booksellers in Leipzig and the Hague before the war. The collection is specially rich in the works of U.S., South American, Finnish, Swedish, German, Swiss, Italian and English mycologists and plant pathologists.

Dr. Mundkur's gift is a valuable addition to the scientific endeavours of Maharashtra in general and Poona in particular. The collection for the present will remain with Dr. Mundkur so that he can use it in his investigations.

At a meeting of the Council of the **National Institute of Sciences of India**, held on Thursday, the 3rd October 1940, in the rooms of the Royal Asiatic Society of Bengal, Calcutta, the following gentlemen were declared to have been elected Fellows of the Institute: *Ordinary Fellows*—Rai Bahadur Dr. K. N. Bagchi, B.Sc., M.B., D.T.M., F.I.C., Chemical Examiner to the Government of Bengal and Professor of Chemistry, Calcutta Medical College. Dr. K. Ahmad Chowdhury, B.A., B.Sc., M.S. (Syracuse, U.S.A.), D.Sc. (Edin.), Wood Technologist, Forest Research Institute, Dehra Dun. Dr. Mohammad Ishaq, M.Sc., Ph.D., Head of the Dept. of Physics, Muslim University, Aligarh. Prof. K. B. Madhava, M.A., Professor of Mathematical Economics and Statistics, Mysore University. Dr. D. N. Majumdar, M.A., Ph.D., F.R.A.I., Lecturer in Anthropology, Lucknow University. Dr. D. Narayanamurti, M.Sc., Dr.Ing., A.I.C. F.Inst.P., Officer-in-Charge, Wood Preservation Section, Forest Research Institute, Dehra Dun. Dr. Vishwa Nath, M.Sc., Ph.D., F.R.M.S., Lecturer in Zoology, Government College, Lahore, Dr. S. C. Roy, D.Sc., Director of the Burma Meteorological Service, Prof. S. K. Roy, Ph.D., Professor of Geology, Indian School of Mines, Dhanbad, Prof. N. A. Yagnik, M.A., D.Sc., A.I.C., Professor of Chemistry, Forman Christian College and Reader in Chemistry, Punjab University, Lahore. *Honorary Fellows:*—Sir Rickard Christophers, Kt., Bt.-Col., C.I.E., O.B.E., F.R.S., I.M.S. (Retd.).

Mysore Dasara Honours.—Among the recipients of distinctions which His Highness the Maharaja of Mysore bestows annually on officers and public citizens for rendering meritorious service to the State are Mr. B. Venkatanaranappa, Retired Professor, Central College, and Diwan Bahadur K. Ramaswamy, J.P., of Bombay Public Works Department. The former was practically the first scientist in South India who conceived the idea of carrying the developments of science to the people in their own language. Besides, his contributions to Kannada literature and to the preparation of Kannada Dictionary are well known to scholars. Diwan Bahadur K. Ramaswamy is blessed by Providence with worldly goods which he has lavishly used in the noblest spheres of service, *viz.*, relief of human suffering and education of impecunious youth. Diwan Bahadur Ramaswamy is awarded the title of Rajakaryaprasakta in appreciation of his disinterested spirit of benefaction, and Prof. Venkatanaranappa as a scholar and disseminator of scholarship. We congratulate them as well as the other recipients who have done equally great service in various capacities.

ASTRONOMICAL NOTES

The Sun will be at the winter solstice on December 22.

Planets during December 1940.—The three planets Mercury, Venus and Mars continue to be morning stars during the month. Venus is slowly approaching the sun in the morning sky and rises about two hours before sunrise. Very near it, can be seen, Mars as a ruddy star of the second magnitude and there will be a conjunction of the two on December 2, the angular distance at closest approach being less than a degree and a half.

Jupiter and Saturn are apparently near each other and are favourably situated for observation, being on the meridian at about 8–30 p.m. The former reaches a stationary point of its geocentric orbit on December 31, when it will resume its eastward motion among the stars,

Saturn's rings can be seen fairly widened, the angular dimensions of the major and minor axes of the ellipse being 44″·3 and 14″·2. A close conjunction of the planet with the moon will occur on December 11. Uranus is slowly moving westward in the constellation Taurus and will be near the meridian at 10 p.m.

The Geminid Showers.—The maximum display of these interesting meteors may be expected about December 10–12. The radiant point is situated in R.A. 7^h 12^m Declination 33° North, in the constellation Gemini. The average hourly number of meteors in this group is about 30.

Minima of Algol.—The star β-Persei (Algol) is a well-known eclipsing variable with a period of 5^d 2^h 17^m and a range of light variation between magnitudes 2·2 and 3·5. Some of the minima that can be conveniently observed, will occur on December 14, $2^h·0$; December 16, $22^h·8$ and December 19, $19^h·6$, (Indian Standard Time). The position of the star is given by R.A. 3^h $4^m·2$ Dec. 40° 43″·6 North. The change in brightness is noticeable about an hour and a half before and after the times given above.

T. P. B.

MAGNETIC NOTES

Magnetic conditions during the month of October 1940 were on the whole similar to those during the preceding month. There were 10 *quiet* days, 19 days of *slight* disturbance and 2 of *moderate* disturbance as compared with 8 quiet days, 16 days of slight disturbance and 6 of moderate disturbance during October 1939.

The day of largest disturbance in October 1940 was the 26th when a moderate magnetic disturbance was recorded. The quietest day during the month was the 9th. The characters of individual days are given in the following table.

Quiet days	Disturbed days	
	Slight	Moderate
4, 5, 9·12, 17, 23, 24, 29.	1–3, 6, 8, 13–16 18–22, 25, 27, 28, 30, 31.	7, 26.

One moderate storm was recorded during October 1940 as compared with two storms (one of great intensity and the other moderate) which were recorded during the same period of 1939.

The mean monthly character figure for October 1940 is 0·74 as against 0·97 for the same period of last year.

M. R. Rangaswami.

SEISMOLOGICAL NOTES

During the month of October 1940, one great, six moderate and two slight earthquake shocks were recorded by the Colaba seismographs as against two moderate and one slight ones recorded during the same month in 1939. Details for October 1940, are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Remarks
		H.	M.	(Miles)		
1940						
October 4	Moderate	10	06	1550	Near 33° N., 91° E., in Tibet	
4	Great	13	25	10170		
6	Slight	21	09	10030		
7	Slight	12	13	3600		
12	Moderate	00	11	10050		
22	Moderate	12	07	3160		
27	Moderate	11	06	10070		
31	Moderate	10	50	1710		
31	Moderate	16	14	300	Near 22°·5 N., 70°·5 E., in north-west Kathiawar	Felt at many places in Kathiawar. Damage to some buildings reported in Rajkot.

ANNOUNCEMENTS

Third All-India Obstetric and Gynaecological Congress. The Third All-India Obstetric and Gynaecological Congress will be held this year in Calcutta from the 27th to the 30th December 1940 both days inclusive.

The subjects for discussion are: (1) Anaemia of Pregnancy; (2) Functional Uterine Haemorrhage; and (3) Maternity and Child-Welfare.

For particulars please apply to the Joint-Honorary Secretaries, Bengal Obstetric and Gynaecological Society, 91 B, Chittaranjan Avenue, Calcutta.

All-India Medical Conference.—The Seventeenth All-India Medical Conference will be held in Vizagapatam on December 27, 28 and 29. A Reception Committee with Dr. B. Tirumala Rao, Superintendent, King George Hospital, as Chairman has been formed for the purpose. Dr. K. S. Ray of Calcutta, General Secretary of the Indian Medical Association is the President-elect of the Conference.

An Industrial Exhibition and a Scientific Exhibition are being organised in this connection and "A Handbook and Souvenir" of the Conference will be published on the occasion. A series of popular lectures by eminent medical men are arranged.

Arc Welding Research Award.—The *James F. Lincoln Arc Welding Foundation* of Ohio, U.S.A., has announced a "$200,000 Industrial Progress Award Programme" which covers the period extending from January 1, 1940, to June 1, 1942. The programme is briefly to stimulate general industrial progress by encouraging research and study on the subject of arc welding and by rewarding authors of papers judged worthy of award, which report and describe advances or improvements in design, manufacture, fabrication, construction, welding service or maintenance resulting from such research and study.

The *India Society of Engineers* have arranged to serve as local Information Bureau of the J.F.L. Arc Welding Foundation. Those who are particularly interested in arc welding and wish to contribute papers may send for particulars from the Secretary, India Society of Engineers, 7, Clive Street, Calcutta.

Lucknow University.—The following is the programme of Winter Session Lectures for 1940-41:—

December 3, 4 and 5 at 6-30 p.m. (Biology Theatre)—Dr. S. S. Joshi, D.Sc. (Lond.), Principal, Science College, Benares Hindu University: "New aspects of molecular activation".

December 7 at 6 p.m. (Chemistry Theatre)—Mr. M. Raman Nayar, B.A., A.I.I.Sc., Lecturer in Chemistry, Lucknow University: "A chemical method of preventing seepage losses of water in canals".

December 20 at 6-30 p.m. and December 21 at 2-30 p.m. (Biology Theatre)—Dr. J. C. Ghosh, D.Sc., F.N.I., Director, Indian Institute of Science, Bangalore: "The photo-chemical action of polarised light".

December 21 and 23 at 6-30 p.m. (Biology Theatre)—Prof. L. Rama Rao, M.A., F.G.S., Department of Geology, Central College, Bangalore: "The Cretaceous rocks of the Indian Peninsula".

January 9 at 2-30 p.m. (Biology Theatre)—Prof. A. Subba Rao, D.Sc., F.R.M.S., Central College, Bangalore: "The mammalian ovary".

*January 9 at 6-30 p.m. (Biology Theatre)—Prof. M. N. Saha, F.R.S., Palit Professor of Physics, Calcutta University: "Fission of nuclei".

January 10 and 11 at 1-30 p.m. (Mathematics Dept.)—Dr. Ram Behari, M.A. (Cantab.), Ph.D., Reader in Mathematics, Delhi University: "Differential geometry of ruled surfaces".

January 10 and 11 at 6-30 p.m. (Biology Theatre)—Prof. R. Gopala Aiyar, Department of Zoology, University of Madras: "Some aspects of marine biological research in Madras".

January 13 and 14 at 6-30 p.m. (Biology Theatre)—Dr. H. J. Bhabha, Ph.D., Department of Physics, Indian Institute of Science, Bangalore: "Cosmic radiation".

January 15 at 6-30 p.m. (Biology Theatre)—Dr. M. B. Lal, D.Sc., Lecturer in Zoology, Lucknow University: "The early history of helminthology in India".

January 16 at 6-30 p.m. (Biology Theatre)—Dr. G. S. Thapar, Ph.D., Reader in Zoology, University of Lucknow: "Hydatids in animals".

January 17 and 18 at 6 p.m. (Chemistry Theatre)—Dr. A. C. Chatterji, D.Sc., Dr.Ing., Lecturer in Chemistry, University of Lucknow: "The electric double layer and the stability of colloidal solutions".

January 23, 24 and 25 at 6-30 p.m. (Biology Theatre)—Prof. N. N. Sen Gupta, M.A., Ph.D., P.R.S., Professor of Philosophy, University of Lucknow: "The interlacings of the mind: (*i*) The mind and the social setting. (*ii*) The mind and the racial setting. (*iii*) The mind and the geographical setting".

January 30 and 31 at 6 p.m. (Chemistry Theatre)—Dr. S. N. Shukla, Ph.D., Lecturer in Chemistry, University of Lucknow: "Liquid junction potentials".

February 7 and 8 at 6-30 p.m. (Biology Theatre)—Dr. A. N. Singh, D.Sc., Reader in Mathematics, University of Lucknow: "The Lebesgue integral".

February 12 at 6 p.m. (Physics Theatre)—Dr. K. N. Mathur, D.Sc., Lecturer in Physics, University of Lucknow: "The solid state".

February 15 at 1-30 p.m. and February 17 at 3 p.m. (Chemistry Theatre)—Dr. S. M. Sane, Ph.D., Reader in Chemistry, University of Lucknow: "The chemistry of haemin and allied substances".

February 20, 21 and 22 at 6-30 p.m. (Biology Theatre)—Dr. R. D. Misra, Ph.D., Lecturer in Mathematics, University of Lucknow: "The stability of crystal lattices".

February 27 and 28 at 6-30 p.m. (Biology Theatre)—Mr. Kali Prasad, M.A., LL.B., Lecturer in Philosophy, University of Lucknow: "Psychological typology".

All the lectures will be illustrated.

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*These dates are provisional.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences: (*Proceedings*)

October 1940. SECTION A.—V. SURYAPRAKASAM: *Effect of temperature on the ultrasonic velocity in liquids.* Eleven organic liquids have been studied over range 30° C. to 120° C. All liquids exhibit a diminution of sound velocity with rising temperature, the rate being of the order of 3 to 5 metres per second per degree. C. N. SRINIVASIENGAR: *Some properties of rectilinear congruences.* M. R. ASWATHA NARAYANA RAO: *Sulphuryl iodide.* Spectroscopic studies indicate that sulphuryl iodide is produced by the action of potassium iodide on a dilute solution of sulphuryl chloride in CS_2, at −70° C. R. D. DESAI AND V. M. VAKIL: *Heterocyclic compounds—Part XI. The application of the Pechmann and the Kostanecki reactions to γ-orcacetophenone.* S. RAMACHANDRA RAO AND S. ARAVAMUDACHARI: *Diamagnetism of Phosphorus.* The diamagnetic susceptibility observed when white phosphorus is dissolved in carbon disulphide, is larger than the value calculated from additive law. C. J. DASA RAO, T. R. SESHADRI AND J. VEERARAGHAVIAH: *Chemical investigation of Indian fruits—Part II.—The composition of the oil from the seeds of Indian shaddock.* P. SURYAPRAKASA RAO AND P. PRABHAKARA REDDY: *Occurrence of herbacetin in the flowers of the Indian tulip* (Thespasia populnea). Both populnetin and herbacetin are present, and their relative proportion seems to vary considerably depending on the season of collection of the flowers. S. RANGASWAMI AND T. R. SESHADRI: *A note on certain constitutional factors controlling visible fluorescence in compounds of the benzo-pyrone group.* A hydroxyl group in 7-position causes fluorescence in the coumarins. P. S. VARADACHARI: *Secondary electron emission of nickel at the Curie point.* No sudden alteration in the secondary electron current was observed at the Curie point (358° C.). R. D. DESAI AND (MISS) V. M. VAKIL: *Studies in the Friedel-Crafts reaction—Part VI. Further evidence for γ-substitution in the resorcinol and orcinol derivatives.* V. SEETHARAMAN: *On the existence of a metric for path-spaces of order two.* HANSRAJ GUPTA: *On a table of values of L*(n). M. R. ASWATHA NARAYANA RAO: *Selenium iodide.* Selenium iodide is formed by treating dilute solution of selenium chloride in CCl_4 with dry KI. B. D. SAKSENA: *Raman spectra of some esters of di-carboxylic acids. Oxalyl chloride, ethyl- and methyl-oxalate, ethyl malonate, ethyl phthalate, ethyl fumarate, ethyl maleate and oxalic acid.*

October 1940. SECTION B.—S. N. DAS GUPTA AND G. S. VERMA: *Studies in the diseases of* Mangifera indica *Linn.—II. Effect of injecting healthy mango fruits with extract from naturally occurring necrotic mangoes.* J. B. S. HALDANE: *The estimation of recessive gene frequencies by inbreeding.* Y. APPAJEE: *A note on the relative positions of the corpus callosum and the hippocampal formation.* JAI CHAND LUTHRA, ABDUS SATTAR AND SARDUL SINGH SANDHU: *Experiments on the control of smut of sugarcane* (Ustilago scitaminea *Syd.*). M. S. RANDHAWA: *Some peculiarities in conjugation in a new Himalayan species of* Zygnema. URSULA PHILIP: *A genetical analysis of three small populations of* Dermestes vulpinus *F.* (*Coleoptera*). JAI CHAND LUTHRA, ABDUS SATTAR AND SARDUL SINGH SANDHU: *Some studies on the physiology of* Cytospora sacchari *Butl., the causal fungus of stem canker disease of sugarcane.*

Indian Chemical Society:

August 1940.—(Late) N. W. HIRWE AND K. N. RANA: *On chloralamides. The reaction of potassium cyanide on a-chlorochloral-chloro-2-methoxy-benzamides and the hydrolysis of the resulting cyano compounds.* MAHAN SINGH AND ARJAN SINGH: *Cyanocamphoranilic acids and their rotatory powers.* S. M. SETHNA AND R. C. SHAH: *Kostanecki-Robinson reaction—Part II.—Propionylation and butyrylation of orcacetophenone and its monomethyl ether.* GURCHARAN LAL JUNEJA, KARTAR SINGH NARANG AND JNANENDRA NATH RAY: *Sulphonamides—Part I.* PRAFULLA KUMAR BOSE AND PHANIBHUSAN DUTT: *On the constitution of pedicinin.* MATA PRASAD AND B. G. SHEJWALKAR: *Viscosity of Thorium arsenate gels during setting.* S. S. BHATNAGAR, B. D. KHOSLA AND RAM CHAND: *Magnetic evidence regarding the state of metallic ions in phosphate glasses.* N. R. DHAR AND E. V. SESHACHARYULU: *Nitrogen fixation and total bacterial count on the application of energy materials to alkali soils.* PRIYADARANJAN RAY: *A note on the reactions and exchange of active iodine in inorganic system.* N. V. SUBBA RAO AND J. VEERABHADRA RAO: *A note on the occurrence of free fatty acids in the cake of* Pongamia glabra.

Meteorological Office Colloquium, Poona:

October 7, 1940.—RAO BAHADUR V. DORAISWAMY IYER: *Formulae for forecasting seasonal rainfall in Mysore and South Madras.*

October 15, 1940.—MR. V. V. SOHONI: *Past climates.*

October 22, 1940.—MR. A. K. ROY: *Isentropic analysis of weather charts.*

ERRATUM

Vol. 9, No. 10, October 1940:

Review Article entitled "Excavations at Harappa", para 5, line 6, *for* "Mr. Vats" *read* "Mr. Mohammad Sana Ullah".

1726-40—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.

Current Science

With Best Wishes

for a Happy Christmas

and a Bright New Year.

May it bring peace and

goodwill among mankind.

CURRENT SCIENCE

Vol. IX] DECEMBER 1940 [No. 12

ARMING FOR PEACE

A BUSINESS man of large experience when about to sign an agreement defining the future relations between his firm and another party, remarked: "We must remember that an agreement is simply a memorandum of what both parties intended at the time of signature. It is impossible to draw up a form of agreement, out of which a way cannot be found, if either side lacks honesty or goodwill." The present war is largely due to the mistake of relying upon "pacts" without being assured of the necessary background of HONESTY and GOODWILL.

In considering the subject of "Arming for Peace" on which the Editor of *Current Science* has requested an article, it would seem necessary in the first place to examine the ultimate foundations on which these two essential factors of peace must be based.

We must realize then that honesty is something more than "the best policy". Hitler, indeed, has worked out a technique of lying, amongst other items of which is the subtle propagation of half-truths, designed to confuse issues, and to deceive even well-intentioned people. It is unfortunately often the case that lack of wisdom with good intent, may be as mischievous in its results as intellectual subtlety with evil intent. A mouse by causing a short circuit in the power house has put a whole city in darkness.

True honesty must get down to the bases of thought and resulting action. "Clear your *mind* of cant" said the rough spoken but essentially honest Doctor Johnson. This means the unwearied endeavour to reach the truth about any situation. To the old question—"What is Truth?" the reply may

be made that Truth is that which is capable of being "known", as apart from what is merely surmised or believed. The advance in physical science has consisted in the substitution for crude theories and superstitions, of demonstrable knowledge more closely in accord with truth. So in the field of religion, in which may be included all those interests which concern the spiritual rather than the material welfare of man, the same process may be noted. It is not so very long since the majority of religionists, Christian and other, believed in the "plain flat-footed hell" of the Fundamentalist and of Calvinistic theology, the nightmare arguments about which rocked the sanity of the gentle-minded Cowper. These beliefs may still be found "under cover". Even though we may no longer believe in the eternal burning of unbaptized infants, we have all read of, if we have not seen, the mangled bodies of the innocents, massacred by the modern Herod.

It is clear, then, that while the old meaning of being "saved" was to be freed from fear or punishment in a hell of fire and brimstone after death, our present need is to be rescued from the constant menace of the hell of war.

There is a gruesome picture in a small museum in Brussels devoted to the works of the half crazy artist Wiertz entitled: "Napoleon in Hell" where the dictator of that day is seen in an atmosphere of flame, filled with the cursing faces of the women who had lost husbands and sons in his wars. We shall not dispose of Hitler or Hitlerism by hating after this fashion.

To "know" the truth about any situation or individual it is necessary to be absolutely honest with ourselves. The attainment of such honesty is not easy. It means the casting out of the mind of all suggestions which do not measure up to our highest sense of good. We must learn, *i.e.,* continually to reject these "suggestions" and to recognize the clarity of perception which accompanies the "knowing" of truth. In proportion as we are successful in this task we shall be less liable to be led astray by the half-truths of Hitler or any other propagandist.

This, which may be called the "way" of Truth has been known to enlightened thinkers through the ages. Apart from prophets and philosophers hints are to be found in the writings even of such pioneers in physical science as Paracelsus and Van Helmont, blurred though they may be with the mist of error.

A man may slowly arrive at the Truth through stress or misfortune, or he may awaken to it suddenly, just as some accidental incident may reveal to him that he is in love.

That one member of a scientific research staff who had spent happy student days and made many friends in Copenhagen became almost physically ill at the thought of the muddy vileness of the Nazi overflowing of Denmark, is evidence of real emotional reaction and honest indignation. Mr. Gandhi's tears, when first made aware of the possible destruction of ancient monuments in London, also indicate a flash of "clear perception" Sad that it should so soon be clouded over with religio-political subtleties, suggestive of a spiritual "smart Alec" rather than an inspired leader. The self-imposed and well advertised martyrdoms of the satyagrahis fail to impress those whose friends and relations are quietly going about their

avocations in England in daily peril of their lives.

What to the plain man seems a treacherous taking of political advantage is not likely to inspire confidence in the justice of the propagandists in their other relations to public life.

In a conference held by a religious body many years ago in Manchester, during a discussion on the value of creeds, it was finely said by one speaker—"In the last analysis it is character which counts."

It seems to be forgotten that "Votes for Women" were conceded not because of the hysteria of the suffragettes, but because when war came all these extravagances were forgotten and women were found in the munition factories, in the transport services and in other spheres of activity efficiently carrying on the work of their husbands, sons and brothers in the trenches, and so *proving* their fitness for the responsibilities of citizenship.

The driving force behind the women's suffrage movement was, moreover, not mainly political, but was born of a passionate resolve to end if possible the exploitation of women by reason of the possessive and acquisitive inclinations of society. In the peace for which we are arming it may be hoped that exploitation in any form of the weak by the strong will be universally condemned.

Although a fierce civil war was fought for the intended "abolition of slavery", it is doubtful whether even yet it is fully realized that cash is not the equivalent of kindness, and that what is sometimes termed "wagery" may be even more soul destroying than "slavery".

A difficulty which may be encountered in our endeavour to "know" the Truth is that many of us are mental "flatlanders" unable to perceive anything outside our 2-dimensional consciousness. With perseverance and continued honesty of purpose and desire, we may attain to a 3- or even to an n-dimensional consciousness. IDEAS, after all, are not dimensional at all. Thus it happens that those of humble mind who are willing to listen and learn, may arrive soonest at clarity of perception. With this clarity comes real POWER. Hitler, with all his concentration camps and Gestapo officials, has not the power of a little dog to inspire affection, or to heal one heart-break.

Among the four most "powerful" men the world has known, Bertrand Russell includes Galileo, who was free from fear through his perception of the reign of law in physical phenomena. Others, seeing further even than Galileo, have realized the reign of law in the spiritual or undimensional world of ideas.

A main cause of war is *fear*. Why should we fear for our foothold in life if, like Galileo, we know that we are supported on the girders of the universe? Why should we fear poverty and lack when the resources of the world are available to all, if intelligent ideas are rightly applied?

Why fear sickness when the poisons of hate and envy, greed and jealousy, malice and resentment have been eliminated from the system by the cleansing of the mind?

And what of that "undiscovered country" which "troubled the will" of Hamlet? What does the chrysalis know of the butterfly or the acorn of the oak, or either of these of the never ending life which passes from form to form?

Apart from these fears born of forgivable limitations of consciousness, another alleged cause of war and unrest is *boredom* arising from ignorance, apathy and inertia. Even war may be preferred to dullness and lack of interesting occupation. Hence the success of the appeal of the Nazi and Fascist to the unemployed or mentally unoccupied youth of Germany and Italy. In arming for peace as for war, it is wise to be willing to learn from the enemy, since many of his ideas may be, in themselves, good, though inverted by him in order to serve the purposes of evil.

The writer in his younger days was privileged to be on terms of friendship with a learned lexicographer and master printer, from whom he often caught words of wisdom. On one occasion the dear man remarked—"You know the apparent dullness of a subject is often simply a measure of our ignorance of it" and proceeded to prove his point by discoursing charmingly on Chinese ideographs!

When we become conscious of the world of *Ideas,* our vision will be immensely enlarged and we shall come into our inheritance of joy, already glimpsed by the artist, the poet and the scientific worker, by all those indeed whose activities are creative and not simply self-regarding. When all men see these things there will be peace, for the roots of discord will be cut away.

To know these things does not require learning or wealth. The Madras fisherman in his catamaran brings expert ability to bear on his job, equally as effectively as the zoologist in his laboratory. The artistic arrangement of flowers in a vase may be the gift of an Indian "room-boy", as well as the taught accomplishment of the Japanese "geisha". Nevertheless it would be well if it were more generally realized that "simplicity" of life does not mean squalor or lack of "fineness".

HONESTY and GOODWILL—two simple words, best understood by simple folk. It may well be that only such will be present at the final Peace Table, since they alone represent the common people who always bear the chief burden of the calamity of war. They are the people who will stand for tolerance and fair-play. Even in a slum street fight they are those who shout "Go it little 'un!" While these simple folk may not all belong to the poor or "underprivileged" classes, they will many of them know what it is to be out of employment and to wonder where the next week's wages, or the next month's or year's salary, is to come from. Many will have seen their homes crashing in the air-raid, will have shared these dangers with their wealthier neighbours and will have been welded into a common brotherhood with them. A social revolution, truly, but with no hint of tumbrils.

At the peace table or in the peoples parliament to follow, we may hope to sec the sons and brothers of the "simple folk", who will bring to their duties as representatives of the people courage, quickness of apprehension and power of prompt decision, learnt in the skies, on the tumbling seas, or during the patient vigil of the watching post.

These "simple folk" will take no joy in revenge, but will gladly welcome decent people of all nationalities and races into a commonwealth of mutual service. The moral "sickness" of "others" they will hope to see healed in course of time in the atmosphere of compassion arising from "understanding".

Should there remain individuals too dangerous and criminal to be allowed at liberty, they may be dealt with in a spirit of justice and equity, with a view equally to their own good and to that of society.

The "simple folk" will welcome the special qualities and aptitudes of all nations and peoples in so far as these contribute to the general welfare of humanity.

The "simple folk" will have come to realize clearly through the hard facts of their economic life that *money* is not *wealth*, and they will seek to free the world from the age-old illusory worship of gold with all its attendant miseries.

They will strive to bring about the substitution of true business founded on fair exchange of goods and services for the scramble of the market place, and competition in excellence for the crude competition of the profit motive, which is only a form of continuous war.

At the peace table there must be wide tolerance for differences in culture and religion. The "simple folk" will not despise any who may not have climbed the hill of understanding so far as to be able to see the view which they see, nor will they envy those who are higher on the mountain side than they. All, they are well aware, will reach the summit at last.

The people of honesty and goodwill are not likely to find difficulty in replying to the common arguments of the defeatist. How, it may be questioned, can men and nations of different language, religion and culture live and work together? The answer may be that there are things on which all men of honesty and goodwill are agreed which are amply sufficient to give plenty of work for any form of Federal Government. For the rest let those things on which there cannot be agreement be left to the care of each body concerned. Let Hindus attend to the special interests of Hinduism, Muslims to the affairs of Islam. So with Catholic and Protestant, Teuton and Latin, Celt and Saxon. Successful examples of such collaboration are not hard to find, given honesty and goodwill, notably Switzerland, Canada, or as a nearer instance even the State of Mysore.

It is evident that a successful peace must depend on the number of "simple folk" available of the type indicated. It is for each one of us to seek to qualify for a seat at the table by daily and continued effort to increase our understanding of the inner meaning of HONESTY and GOODWILL. It will involve striving, not spasmodically, but minute by minute, hour by hour, day by day to attain a clearer vision of the essential truth of things, by the process of mental cleansing already described. This may mean some sacrifice of ease and occasional weariness of spirit. "Thinking is the hardest work there is" says Henry Ford. One of the members of the Indian Defence Force in the last War has not forgotten the words of the officer instructing the newly joined recruits: "You may think", he said, "that all these drills and tiresomely detailed instructions are rather useless; but remember that when it comes to the 'real thing' if you do not instinctively know your drill, you will be 'all over the place', whereas with training, it may be hoped that you will retain some sort of order".

In such manner, therefore, let us arm for Peace.

GILBERT J. FOWLER.

GENESIS OF EARTH

In dim, impenetrable, mystic dawn of time
The Grand Designer set the worlds in space
To revolve restless and fly in starry speeds
Unclashing;—each in its assigned airy path
All held in bonds unseen and knit in space
To fit His lofty plan of Firmament
Of endless, star-strewn, growing universe.

In times unknown—some tens of trillion years ago
When the wearied Watcher drooped His wary eye,
Two vagrant stars from depths of space onrushed
And crashed to myriad bits;—their smithers afire
Did blaze in space to mass incandescent.
Hurtled loops of these shattered stars tied down,
Like fleeting souls to mortal trails awhile
Flew round and round; their cruel fate cursing
Which sped their promising life to tragic end.
Some wailing waifs outswerved their orbit course
And clashed again; but venomless, firm and true
That they, like clasping drops of silver live
Cohered anew and grew as glowing worlds.
From the roving wrecks thus fused afresh arose
Our Earth and Mars and rest planets diverse,
Which speed around the re-built nuclear sun,
As specks of sands in endless ocean space.

Or perchance, the cooling star-crashed nebular globe
Gave birth at first to our luminant central sun
Who, turning topwise in terrific speed, thrust out
His glowing gaseous sward to swollen knots
Which, cut and hurled aloft, went swirling out
To whirl round him in pointed paths; such ejected knots
Of gaseous globes cooled, in stages diverse,
To deck the sky as planets of varied size
And that which chilled to air-filled stony crust
Evolved as Earth, to hold our souls in trust.

R. R. B.

A CENTURY OF LIEBIG'S THEORY OF MINERAL NUTRITION OF PLANTS AND OF SOIL FERTILITY

BY

B. VISWA NATH

(Imperial Agricultural Research Institute, New Delhi)

IT is now a century since Liebig, the German Chemist, announced in the year 1840, his theory of the mineral nutrition of plants and soil fertility. The announcement is not only an important landmark in the progress of knowledge of the chemistry of plants and the science of plant nutrition and crop production, but is the foundation of Agricultural Chemistry as we know it to-day.

The history of science abounds with instances in which thought and research changed from time to time following discoveries of fundamental importance. Such discoveries, eventually directed experiment and thought into new fields, leading to new knowledge and expansion in scientific outlook, without at the same time invalidating previous knowledge and experience. Liebig's theory is an example in point. It will be interesting and instructive to briefly recapitulate the major developments leading to Liebig's theory and to review the experience and the trend of research and thought on soil fertility and plant nutrition during the century that has elapsed.

Till Liebig expounded his views in the year 1840, the "humus theory" of plant nutrition held the field and it was believed that plants should be nourished by a substance of a similar nature. Chemistry and Agricultural Chemistry as they are known to-day had their beginnings in the mists of alchemy. In those days the knowledge of the constitution of matter was only in terms of the four elements or primordial materials of the Aristotelian philosophy, *viz*., fire, air, earth and water. Towards the end of the sixteenth and the beginning of the seventeenth centuries Paracelsus taught that life was a chemical process and that the bodies of animals and plants were chemical laboratories. The belief was held that compounds manufactured by life processes in the bodies of animals and plants could not be made in the laboratory.

The discovery of several chemical elements in rapid succession between the years 1750 and 1800 and the development of quantitative methods of experimentation by Lavoisier and de Saussure marked the beginnings of Agricultural Chemistry and the study of the chemical composition of plants received a powerful impetus. The synthesis of urea in the laboratory by Wöhler in 1828 was another step in advance. It finally disposed off the distinction between substances made by life-process in the bodies of animals and plants and those made in the laboratory. These developments opened up fresh fields of enquiry and led Liebig to turn his attention to plant chemistry. He made chemical analyses of the ashes of plants and manures, carried out experiments on a piece of uncultivated land at Gissen and discovered that by applying to the soil nothing but mineral salts he could turn the land into as fertile a spot as could be found in all Germany. He discovered that plants could absorb minerals and assimilate them and could manufacture their organic materials from air and water. He attributed the effectiveness of farm-yard manure to the mineral salts of phosphorus, potassium, sodium, calcium, magnesium and others contained in the manure and also found in plant ashes, dismissed the humus theory and announced his mineral theory of plant nutrition and soil fertility.

Although this announcement raised a bitter controversy in the beginning, its value was eventually recognised. Liebig, by analysis and synthesis of the then existing data, clarified the ideas on plant nutrition, placed them on a scientific footing and simplified manuring of crops. A chemical analysis of the soil would indicate what was lacking or inadequate in it and the restoration of the lacking or inadequate element to the soil would restore its fertility. It was all so simple and easy, and therefore these ideas of chemical treatment of the soil rapidly gained favour. The use of artificial or chemical fertilisers became popular and a huge artificial fertiliser industry had arisen.

The earlier experiences in the practical application of the theory to the humus rich

soils of the temperate climates of Europe gave such unqualified support to the theory that it was believed that artificial or chemical fertilisers could for ever effectively substitute farm-yard manure and other organic manures. The belief developed that farming might be only chemistry and a matter of supply of mineral salts to the soil. Plant nutrition came to be regarded as entirely a matter of direct mineral absorption and plant nutritional and agrobiological concepts have been developed and interpreted in terms of fertiliser elements.

Subsequent developments provided evidence that soil fertility was not quite such a simple matter as that. Towards the end of the nineteenth century discoveries, led by Pasteur, of bacteria and his studies on fermentation processes assumed a definite stage and shape, and threw light on the biological processes in the soil, and brought the realisation that in soil fertility there was something more than continuous supply of mineral fertilisers. About the year 1850 Pasteur pointed out that important changes especially oxidations are brought about by Micro-organisms. In 1877 Schloesing and Muntz and a little later Schloesing established the oxidation of soil organic matter to nitrates by bacteria. In 1888 Hellriegel and Wilfarth investigating the problem of nitrate supply and plant-growth observed that while graminaceous plants failed to grow without nitrate supply leguminous plants could do so. This was ultimately traced to symbiotic nitrogen fixation. Towards the close of the century Knox, Winogradsky and others showed that atmospheric nitrogen was fixed in the soil by azotobacter.

The birth of the twentieth century saw the extension of the zone of soil and plant research to countries outside Europe and America and included the hot, humid, and dry tropics. The increase in the number of research workers working under different conditions of soil, climate and crops soon widened the scope of enquiry. Gradually knowledge accumulated. The importance of organic matter and micro-organisms in the soil became apparent. Soil processes and the nitrogen and carbon cycles became clearer. Farmers and experimenters were puzzled by the fact that manures like form-yard manure, relatively poor in mineral plant foods and in their availability, produced equally good and even better results than mineral fertilisers. The long period experiments at Rothamsted in England and at Pusa and Coimbatore in India showed that although in the earlier years mineral or chemical fertilisers could produce better results than farm-yard manure, their continued application tended to decrease crop yields compared to farm-yard manure and green manures. Mineral or chemical fertilisers began to find their place as immensely important but not all-important. The sustained and better action of the organic manures was, however, attributed to the better moisture-holding powers of the soil.

Then came studies on human and animal diets and the discovery of vitamins. Once again vistas were opened up. Workers in animal and plant chemistry began to find common ground. Such important characteristics as sexual differences and sexual reproduction and such vital functions as respiration in plants are recognised to be similar to those in animals in their fundamental principles. But, no such similarities were yet thought of in regard to the fundamental nutritional requirements of plants and animals. The role of organic matter on crop-growth was considered to be only indirect and the existence of accessory factors in plant nutrition similar to vitamins in animal nutrition were either not considered or disregarded.

Bottomley[1] and later Mockeridge[2] announced for the first time that extracts of fermented organic manures gave to plants certain growth-promoting substances which they called "*auximones*" and which they considered essential to plants. The hold of Liebig's mineral theory was still strong and Maze[3] just then showed by water-cultures the importance of trace elements for plant-growth. The views of Bottomley and Mockeridge were vigorously opposed and their results were explained in the light of Maze's results. Bottomley died and Mockeridge in a later communication[4] even abandoned her former views on the direct effect of organic matter on plant-growth.

Nevertheless, the experiences in the field and in the laboratory compelled investigators to revert to this question on the effect of organic matter and manures on soil fertility and the work of the last two decades in India and outside has recorded notable advances and opened up new lines of thought and research.

The work in India of Viswa Nath,[5] McCarrison and Viswa Nath,[6] and Viswa Nath and Suryanarayana[7] has provided a complete picture and has thrown new light on the role of organic matter and micro-organisms in plant nutrition and on the interrelationship between, and the inter-dependence of the three components of the system soil-plant-animal. These workers have shown that organic manures play a part hitherto unsuspected and that they provide certain substances analogous to vitamins which are absorbed and assimilated by plants leading to improvements into the quality of the end products of plant metabolism either as food or seed material. They have stated on the basis of their experimental evidence that:

1. Plants also have accessory food factors, akin to vitamins, for proper development and reproduction.
2. Organic manures have as one of their functions the supply of these accessory food factors.
3. There exists a cycle or chain of accessory factors beginning with soil micro-organisms and ending with returning to the soil through plant and animal bodies.
4. Nutritional factors for animals are associated with nutritional factors for plants.

These views which were published in 1926 not only did not receive acceptance, but even roused opposition due to partly to their newness and the knowledge being incomplete and partly to the difficulties experienced in getting clear of the narrow view-points resulting from a too limited experience. In the few years that have elapsed more data have been obtained in different parts of the world in support of the views mentioned above.

At a discussion held by the Royal Society of London in the summer of 1937[8] the available information scattered in several publications was reviewed and it was recognised that the case established in the nutrition of animals was equally established in the nutrition of the most diverse varieties of cells and that all cells from the lowliest bacterium to the cells of the highest animals carry out the series of reactions leading to the production of energy and growth by the help of substances mostly of the nature of vitamins in animal nutrition.

The isolation of *auxins*, substances concerned in the growth of plants, by Kögl in a crystalline form from urine, malt, yeast, liquid manure and farm-yard manure, and Kögl's observations on the existence of a cycle of growth factors in nature[9] provided further support to Indian work. The work of Thimman,[10] of Link[11] on the role of micro-organisms as factors in the regulation of plant processes; and the work of Link[12] and of others have provided evidence in support of the statement on the effects of organic manures and substances produced by microbial fermentation.

McCarrison and Viswa Nath[13] have drawn attention to another aspect of the subject. They have shown that manurial and fertiliser applications are capable of reacting on plants not only by increasing yields, but also by influencing the quality of the seed and by bringing about changes in the composition and nutritive value of the produce, and that in this respect the produce raised with mineral fertilisers on soils poor in organic matter is inferior to that raised with farm-yard manure. These observations find support in the results of work by Rowland and Wilkinson,[14] Thomas and Thompson,[15] Booth,[16] and of Howard[17] in England; Ysabel Daldy[18] in New Zealand, Tallarico[19] in Italy; Hunt,[20] Breazeale,[21] Thompson[22] in America; Kruger,[23] Kottmier,[24] Wachholder and Nehring,[25] Smallfuss,[26] and of Rudolph Berk[27] in Germany. On the other hand the results of Harris[28] in England, Schunert and his associates in Germany[29] do not support the view that fertilisers and manures influence the nutritive value of crops. In 1936–37 experiments were made in Germany under the joint auspices of the Association for Scientific Research, the National Board of Health and the Society for Nutrition Research. The nutritive value of vegetables grown with animal manure plus fertilisers were tested. On adults the results showed no definite effect. On children the results showed that vegetables grown with animal manure and artificial manure together were superior to those grown with animal manure only. In similar experiments in New Zealand by Chapman[30] vegetables grown on humus-treated soil when fed to school children were found superior to vegetables raised with mineral fertilisers. There are thus two schools holding opposing views and the existence of these differences is the greatest stimulus for further investigation and elucidation.

Although our ideas have undergone changes and notable advances have been made since Liebig's days, the original theory is still valid. But the humus theory which prevailed a century ago is again coming into its own but in a qualified manner. The developments of the past century direct pointed attention to one important aspect, namely, the differentiation between soil fertility and soil fruitfulness. Organic manures and organic fertilisers build up and maintain soil fertility for artificial fertilisers to be fruitful. It is in the recognition of this truth lies the reconciliation of the opposing views. There is also the growing recognition that we are at the beginning of new knowledge and that workers in plant and animal nutrition may increasingly find common interests in the studies on cell metabolism. We are indebted for our present knowledge to the pioneers of the past and look forward to future developments which may give us more knowledge and control over soil fertility.

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10 *Jour. Gen. Physiol.* 1934, **18**, 23.
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12 *Nature*, 1937, **140**, 507.
13 *Loc. cit.*
14 *Biochem. J.*, 1930, **24**, 199.
15 *J. S. C. I.*, 1938, **57**, 210.
16 *Ibid.*, 1940, **59**, 181.
17 *Chem. and Ind.*, 1938.
18 *Nature*, 1940, **145**, 905.
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20 *Ohio Exp. Stn. Ann. Rep.*, 1928.
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26 *Phytopath Z.*, 1937, **5**, 207.
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OBITUARY

Mr. NOSHIR S. DOCTOR, M.Sc., A.I.I.Sc.

A PROMISING scientific career was tragically cut short by the death on May 26th last of Mr. Noshir Shapoorji Doctor, as a result of injuries sustained in a motor-cycle accident at Bangalore. Mr. Doctor was working for the PH.D. at the Indian Institute of Science.

Born on March 4th, 1914, at Broach, near Bombay, Noshir Doctor was educated at the Government High School, Broach, and matriculated in 1931. He joined St. Xavier's College, Bombay, in that year and except for a short break in 1933 at Karachi, was there till 1936, when he graduated with a First Class and Distinction in Chemistry, securing the College Gold Medal. He then joined the Indian Institute of Science, Bangalore, and three years later, secured the M.Sc. degree of the Bombay University and the Associateship of the Indian Institute of Science.

Possessed of sterling qualities of head and heart, Noshir Doctor had won the regard of both his Professors and colleagues. He was a good sportsman and, both at school and college, distinguished himself on the field. He won a number of prizes in sports at the Centenary Celebrations in connection with the anniversary of the late J. N. Tata.

Such a premature death at the age of 26 and at the very threshold of a career that held every promise of being very successful, the news of his tragic death came as a great shock to his many friends at Bombay and Bangalore. To his bereaved parents and relatives we offer our sincere condolences.

J. P. DE SOUZA.

LETTERS TO THE EDITOR

A Note on the Analysis of a Special Complex-Experiment

SOMETIMES it happens that the number of different treatment-combinations of a manurial complex-experiment is $[(p-1)q+1]$ and not pq. Thus, for example, taking the case of a manurial experiment which involves p manures (including no manure) and q times of application, the number of different treatment-combinations is $[(p-1)q+1]$. The analysis of such an experiment cannot be carried cut in the usual way. This note indicates briefly the method of analysis of such an experiment.

The sums of squares for blocks, the treatment-combinations and the residual error are calculated in the usual way by fitting constants, as explained in a previous paper.[1] To get more information about the manures, the time of application and the interaction, the sum of squares for the treatment-combinations is split up as follows:—

Variance due to	*Degrees of freedom*
1. No manure *versus* all the other manures taken together	1
2. Between the different manures (excludes no manure)	$(p-2)$
3. Between the times of application	$(q-1)$
4. Interaction	$(p-2)(q-1)$

The sum of squares for the different items menticned above can be calculated as noted below:—

1. Reduction in the s.s. by fitting constants for block effects, no manure and all the different combinations taken together—s.s. for blocks.

2. Reduction in the s.s. by fitting constants for block effects, no manure and the different manures—(s.s. for blocks + item 1).

3. Reduction in the s.s. by fitting constants for block effects, no manure and the different times of application—(s.s. for blocks + item 1).

4. S.s. for $[(p-1)q+1]$ treatment-combinations—total of items 1, 2 and 3.

P. V. KRISHNA IYER.

Imperial Agricultural Research Institute, New Delhi,

November 29, 1940.

1 *Proc. Ind. Acad. Sci.*, **11,** 369.

Sound Velocity in Liquid Mixtures

In an earlier paper,[1] I proposed a relation between the velocity of sound v in liquids and its molecular volume V, *viz.*, $v^{1/3}V = R$ where R is a constant independent of temperature. It is found that the constant R is an additive function of the chemical composition. Isomeric substances of similar constitution have the same value of R. Further the difference in R between successive members of a homologous series has a constant value independent of the type of compound. The mean difference corresponding to the value of R of the CH_2-group has been found from the examination of several series to be 195.

The velocity of sound in mixtures of liquids has been determined by a number of investigators[2] either by the method of diffraction of light by sound waves of high frequency or by the Sonic Interferometer. If the values of R of solute and solvent are additive then the value of R for the mixture is simply given by

$$R_{12} = xR_1 + (1 - x)R_2 \qquad (1)$$

where R_1 is the value of R of the solute and R_2 that of the solvent, and R_{12} that of the mixture. x is the molar fraction of the solute. The quantity R_{12} is given by

$$R_{12} = \frac{M_{12} v_{12}^{1/3}}{\rho_{12}} \qquad (2)$$

where v_{12} and ρ_{12} are the measured velocity of sound and density of the liquid mixture respectively; M_{12} is the mean molecular weight, thus $M_{12} = xM_1 + (1 - x)M_2$, M_1 and M_2 being the molecular weights of the solute and solvent respectively. The value of R_{12} calculated from R_1, R_2 and x according to equation (1) is compared with the value of R_{12} obtained from M_{12}, v_{12} and ρ_{12} according to equation (2) and it is found that the agreement is excellent. As an example the results for solutions of butyl alcohol in heptane are given in the following table:—

x	ρ_{12}	v_{12}	R_{12} acc. to (2)	R_{12} acc. to (1)
0·2570	0·7004	1139	1393	1394
0·4843	0·7252	1155	1266	1270
0·7457	0·7603	1190	1125	1128
0·8243	0·7735	1205	1084	1085
1·0000	0·8061	1245	989	..

$R_1 = 989$, $R_2 = 1535$.

Equally good agreement has been obtained for solutions of benzene, carbon disulphide, ethyl acetate in carbon tetrachloride. Equation (1) can, therefore, be applied to determine the values of R_1 or R_2 from measurements of the velocity of sound in, and density of, solutions instead of pure liquids. If the mixture law given in equation (1) is extended to the case where the solute is a solid, it is possible to calculate the velocity of sound in solids. Details will be published very soon.

M. Rama Rao.

Department of Physics,
University of Mysore,
Bangalore,
December 11, 1940.

1 M. Rama Rao, *Curr. Sci.*, 1939, **8**, 510; *Ind. Jour. Phy.*, 1940, **14**, 109.

2 Bergmann, 'Ultrasonics and their Scientific and Technical Applications'.

Ammonia Synthesis from Active Nitrogen and Hydrogen

The classical work of Haber,[1] Le Rossignol,[2] Nernst[3] and numerous others has established the principal optimum conditions for the above reaction produced thermally. Under different types of electrical discharge, however, the ammonia yields are poor even when the variously mixed gases, are activated in the presence of a number of substances. The results have, however, revealed the operation of some significant factors. Anderson,[4] for example, employing slow moving electrons has found that ammonia formation is negligible at voltages short of the ionisation potential of nitrogen; according to Lewis,[6] a mixture of active nitrogen and atomic hydrogen is reactive; Dixon and Steiner[7] observed ammonia with

active hydrogen and nitrogen in the presence of iron, nickel and copper.

Besides these and similar observations which are mainly of theoretical importance, no systematic and detailed information is available in the now considerable literature on active nitrogen in regard to its utilisability for ammonia synthesis. In the course of studies of its interaction produced under a variety of conditions with a wide range of substances, we have found that (*i*) secondary ionisation is practically the only necessary and sufficient condition for the activation of nitrogen, and that (*ii*) its deactivation results by the continued operation of the exciting field. Result (*i*) is at variance with the view adopted in some of the standard works as to the necessity of a "*condensed discharge*"[5]; it serves, however, chiefly to increase the density of ionisation and therefore, of active nitrogen. We have found that hydrogen even in small proportions acts anticatalytically towards active nitrogen. Besides the influence of this factor, it is to be anticipated from (*ii*), that but small yields would follow any reaction involving active nitrogen with a *stationary* mixture of nitrogen and hydrogen under the discharge. The experimental results were in agreement with this deduction. A careful streaming of the glowing gas at an adequate pressure-gradient was of primary importance. The catalyst, selected from amongst materials found previously to be sensitive towards active nitrogen, was placed in the '*after glow*' of the streaming gas. In a large number of cases nitrides were found; these gave ammonia on decomposition with hot water. This, however, changed the catalyst and necessitated its replacement from time to time. The efficiency of the process also suffered as its operation was thus discontinuous. Hydrolysis with water was therefore replaced by interacting the catalyst with hydrogen. The procedure finally adopted consisted in leading over the catalyst, a carefully regulated stream of active nitrogen *followed by that of hydrogen pre-subjected to electrical discharge*. The latter gas reacted with the exposed catalyst to give ammonia directly, which was readily absorbed from the effluent gases. Ammonia yields were appreciable in the cases of magnesium, cadmium, aluminium, sulphur, chromium and monazite. They were comparatively poorer with alumina, zinc, arsenic, tungsten, nickel, selenium, tin, cobalt and calcium. A marked improvement was effected by heating to about 200° C., the catalyst and also *nitrogen before activation.*

The gases were not allowed to mix; the unused portion of either of them could therefore be used over and over again. Furthermore, the activity of any of the catalysts continued unimpaired for long periods. The chief requisite for its successful performance is, that at the working temperature, the nitride formed should be unstable and reactive towards hydrogen. This is illustrated by the fact that but negligible yields of ammonia were obtained, when silicon was employed as a catalyst; its nitride is known to be exceedingly stable and unreactive.

S. S. Joshi.
A. Purushotham.

Department of Chemistry,
Benares Hindu University,
October 10, 1940.

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1 *Zait. Anarg. Chem.* 1905, **43**, 111.
2 *Ibid* 1908, **14**, 181.
3 *Ibid.*, 1907, **13**, 521 ; 1908, **14**, 373 ; 1910, **16**, 96.
4 *Cf.* Mellore, *Comprehensive Treatise on Inorganic and Theoretical Chemistry*, 1924, **8**, 149–51.
5 *Ibid.*, p. 84 ; Kaplan, *Proc. Nat. Acad. Sci.*, 1928, **14**, 258 ; Reyleigh, *Proc. Roy. Soc.*, 1911, **85**, 219 ; Lowry, *Inorganic Chemistry*, 1931, p. 414 ; Partington, *Inorganic Chemistry*, 1933, p. 545 ; Willey, *Collisions of the Second Kind*, 1937, p. 19.
6 *J. Amer. Chem, Soc.*, 1928, **50**, 27 ; 1929, **51**, 654.
7 *Zeit. Physikal. Chem.*, 1931, **14**, 397.

A Light Effect in Chlorine under Electrical Discharge

The marked adaptability of a Siemens' type, glass or silica ozoniser for the production of discharge reactions and especially for enabling

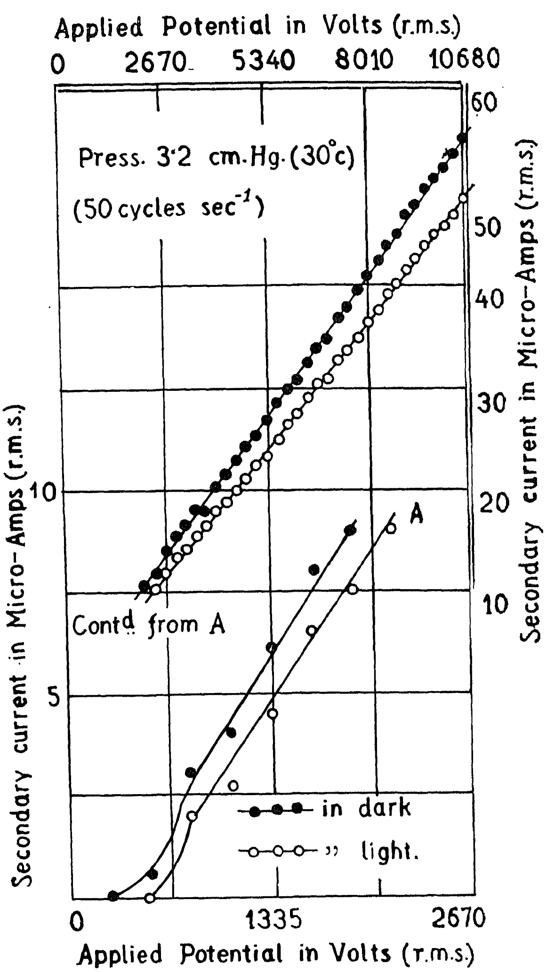
a correlation between the characteristic electrical quantities and the resultant physico-chemical effects was emphasised previously.[1] With but a small extension, the method lends itself conveniently to investigating the above phenomena under an *additional* constraint such as an external magnetic field, irradiation, etc. The inner tube enclosed by the annular space and the outer jacket surrounding the ozoniser, serve both as electrodes and light filters, when filled with an electrolyte solution appropriate to the part of the spectrum selected for irradiation.

It is observed that the *current produced at moderate pressures of chlorine in the dark, is diminished sensibly and instantaneously on exposure to light*; the effect is reversible; on shutting off the light, the discharge current returns to the original value without any lag. With the exception perhaps of a preliminary note published elsewhere,[2] this effect does not appear to have been recorded in the literature.

The phenomenon *called A* for shortness' sake, reported in the *Sci. Cong. Abst.*, refers to a *slow* 'ageing' effect, *i.e.*, the diminution with time of the discharge current at a given applied potential. In A, the recovery of the current after the discontinuation of the discharge is subject to an appreciable lag, whose magnitude depends upon the duration of the previous exposure. In A, 'ageing' is accelerated by light; it is not, however, instantaneous and shows a lag during recovery. What is now reported (called B) is an *instantaneous* effect both when it occurs under irradiation and when it recovers, on shutting it off; there is no lag during recovery in B. Furthermore, B is affected less by the frequency of the A.C. supply than A. B is very much less than A in bromine and iodine vapours; just contrary is the case with chlorine. Further work has shown that B is more analogous to the familiar 'clean up' effects than A. Some marked similarities, however, obtain between A and B, *e.g.*, in respect of the influence of the applied potential and the wavelength of the light used. It would even appear that B is part of A at any rate under certain conditions. It is considered advantageous, however, to study the two effects on a distinctive basis. The present note, therefore, avoids their premature and undue identification.

Mixtures in different proportions of hydrogen + chlorine (occurrence of this familiar photoreaction now produced under the discharge, notwithstanding) and hydrogen + hydrochloric acid gas, hydrogen being always present in excess, also showed the same phenomenon, though not

Fig. 1



so markedly as pure chlorine. In all the mixtures examined so far, the effect increases with the intensity and the frequency of the light.

It is instructive to consider this photo-diminution of the discharge current from the

standpoint of V_m, the *'threshold potential'* of the system.[1,3] As V, the potential applied to the ozoniser is increased gradually, the corresponding current (also the wattage dissipated in the system) increases suddenly at V_m (*cf.* Fig. 1). This quantity also determines the setting in of a chemical reaction in the ozoniser, depending upon the pressure and especially the nature of the reactant material.[1,3] The characteristic current potential curves in Fig. 1 show that the *'threshold potential'* is increased under irradiation. It is to be anticipated therefore that the discharge current produced at a given potential V, would diminish under light, as is actually found to be the case, since it is easily shown that the current depends upon the difference $V - V_m$[1,3]. The typical curves in Fig. 1 also show what has been observed already in a large number of cases that the photo-diminution of current in the discharge increases with the magnitude of the applied potential.

An increase in the frequency of the A.C. supply, and the discharge current, a decrease in the gas pressure and the temperature of the system increase the photo-diminution.

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V. Narasimhan.

Department of Chemistry,
Benares Hindu University,
November 26, 1940.

1 *Curr. Sci.*, 1939, **8**, 548.
2 *Proc. Ind. Sci. Cong.*, 1940, Phys. Sec., p. 24.
3 *Trans. Farad. Soc.*, 1929, **25**, 120.

Photoelectric Efficiency of Iron, Cobalt and Nickel at Different Temperatures in the Soft X-Ray Region

Soft X-rays produced from a thoroughly outgassed target of nickel at room temperature were filtered from ions and electrons by a condenser arrangement and were then made to fall on one of four metal plates fitted into a lantern structure. The four metal targets used were of iron, cobalt, nickel and copper. The framework could be rotated by a magnetic arrangement and each of the targets could be brought successively to the position required for the incidence of soft X-rays. The entire lantern structure was thoroughly degassed before measurements were made, by electronic bombardment from a tungsten filament fixed within this structure.

The photoelectrons produced from the target were attracted by an external shield which was maintained at a potential of 54 volts higher than that of the target. Measurement of the photoelectric current was made by connecting the lantern to a quadrant electrometer and introducing between them a leakage resistance of smoked quartz having a value 10^{11} ohms.

The experiments were carried out at different temperatures of the targets ranging from 30° C. to 950° C. The pressure of the residual gas inside the experimental tube of pyrex was lower than 10^{-6} mm. of mercury as measured by a McLeod gauge.

The photoelectric sensitivity of iron for soft X-rays was found to be constant up to about 780° C. The value decreased by about 10 per cent. in the range 780° C. to 900° C. and thereafter showed a rise. The Curie point of iron is 770° ± 5° C. This temperature also corresponds to the transition point at which α-iron is converted into β-iron. The β-variety is known to be transformed into the α-variety at 910° C. The photoelectric sensitivity of iron is found to show a change at these temperatures. Cardwell[1] has studied the photoelectric sensitivity of iron in the ultra-violet region. Except for an additional inflexion which he obtains at 475° ± 50° C., there is close resemblance between his results and those in the present investigation.

This conclusion that soft X-rays show a similarity to the ultra-violet light from the point of view of photoelectric effect, receives confirmation from the experiments of Rudberg[2] who examined the velocity distribution of photoelectrons produced by soft X-rays. He found that by far the larger part of the photoelectrons had velocities corresponding to the order of a few volts.

Bandopadhyaya[3] has shown that the number (N) of photoelectrons ejected from a target bombarded by soft X-rays generated at an

applied potential V, may be expressed in form

$$N = \frac{1}{2} CK \cdot \frac{eV}{h\nu_0}$$

where C and K are constants depending on the nature of the photoelectric and soft X-ray targets respectively, e is the charge on the electron, h is Planck's constant and ν_0 the threshold frequency. It may be concluded on this basis that the changes in the photoelectric sensitivity of iron at about 780° C. and 900° C. should be due to the changes in the value of photoelectric threshold accompanying the crystalline transformation at these points.

Cobalt and nickel were found to have constant values for their photoelectric sensitivity in the range from 30° C. to 950° C. This fact shows that the photoelectric threshold is unaltered when the hexagonal close-packed structure of cobalt passes into the face-centred cubic structure at 850° C. In the case of nickel, no change of sensitivity occurs at 358° C., the Curie point of this metal. This observation confirms the previous work of Rao[4] on nickel.

Attention may be drawn to the conclusions of Hayakawa[5] who found large changes in the secondary electron emission from iron, cobalt and nickel at temperatures corresponding to their transformation and Curie points. The variation of the photoelectric sensitivity of iron with temperature in the present investigation shows no resemblance whatever to Hayakawa's observations. The results for cobalt and nickel show that there were no changes at the transformation point of 850° C. in the case of cobalt and at the Curie point (358° C.) in the case of nickel whereas Hayakawa found large changes in the secondary emission at these temperatures. Full details will be published elsewhere.

K. S. Sankarasubba Iyer.
Annamalai University,
Annamalainagar,
December 2, 1940.

1 Cardwell, *Proc. Nat. Acad. Sci.*, 1928, **14**, 439; and 1929, **15**, 544.
2 Rudberg, *Proc. Roy. Soc.* (A), 1928, **121**, 385.
3 Bandopadhyaya, *Ibid.*, 1928, **120**, 46.
4 Rao, *Ibid.*, 1937, **159**. 283.
5 Hayakawa, *Sci. Rep. Tohoku Univ.*, 1233, **22**, 934.

Oxidation of Glucose by the Plague Bacillus

Of all the compounds tested for oxidation by the plague bacillus (*Pasteurella pestis*), glucose is oxidised at the highest rate.[1] A detailed study of this oxidation is, therefore, interesting. Some quantitative experiments on the oxidation of glucose by suspensions of the bacillus will be of interest to those working on the intermediary carbohydrate metabolism of bacteria. It was found that the amount of oxygen required to oxidise to completion a given quantity of glucose depended on the previous treatment of the bacteria. The oxidation to completion of added glucose was measured in the presence of air in Warburg manometers at 27° C. The glucose (0·5 or 1·0 mg.) was added to an excess of bacteria (25 mg. dry weight) per vessel suspended in phosphate-buffer at pH 7·4, and the oxygen uptake recorded until it had fallen to the same rate as in the control containing the bacterial suspension only. This occurred in 3 to 4 hours. The experiment showed that for a freshly prepared suspension, which had not been washed extensively on the centrifuge, the oxidation of 1 mol of glucose requires exactly 4 mols of oxygen. The method followed in the preparation of this suspension was to wash off the bacteria grown on agar in Roux bottles into saline or phosphate-buffer and to centrifuge. The bacteria are sedimented while the supernatant contains most of the broth constituents dissolved out of the agar. The sediment was re-suspended in fresh saline or buffer and used at once. However, if all traces of metabolites from the suspension have to be removed, the washing on the centrifuge has to be repeated several times and the suspension left for some time, preferably in the refrigerator (2–4° C.) overnight, so that part of the metabolites stored in the cells may be used up. A suspension treated thus requires 2 mols of oxygen for the oxidation of 1 mol of glucose. If the bacteria are grown as described but with the addition of 2 per cent. glucose to the agar an entirely different oxidation ratio is

observed; the oxidation of 1 mol glucose then requires 1 mol of oxygen only. This variability may be tentatively explained by assuming that the presence of glucose during growth, or the extensive washing to which the bacteria are submitted, uses up or removes important links in the chain of oxidation-reductions present in the cell or in the medium, which may conceivably be coenzymes or other hydrogen-carriers. It has already been shown that cozymase, nicotinic acid and thiamin (Vitamin B_1) catalytically stimulate the oxidation of glucose by these bacteria.[2] Detailed experiments to test this hypothesis by adding the better known coenzymes including the above, however, failed to restore the system fully to the original state.

The detailed manometric study of the oxidation of glucose by the freshly prepared suspension shows clearly that the entire process consists of short steps succeeding each other. Some of these steps may fail to occur in the absence of the corresponding coenzymes. For this purpose the oxygen uptake on adding glucose was measured simultaneously with the carbon dioxide produced with bacteria suspended in phosphate and shaken in air, while the glycolysis (acid-production) was measured with bacteria suspended in 0·025 M. $NaHCO_3$ instead of phosphate and shaken in a mixture of 5 per cent CO_2 in air. Parellel manometers were run containing the corresponding controls. The curves thus obtained for the entire reaction can be divided into three steps, the time relations of which vary a little from one experiment to another. In the first step, lasting usually from the beginning of the reaction to the 30th minute, 2 mols of oxygen are taken up while 1 mol of carbon dioxide and 2 mols (equivalents) of acid are produced. In the second step, from the 30th to about the 80th minute, 1 mol of oxygen is further taken up while 1 mol acid disappears and 1 mol carbon dioxide is produced. In the third and last step another mol of acid disappears and one more mol of oxygen is taken up. The production of acid is thus transitory.

Incidentally the bearing of these results on the technique of fermentation tests employed for the identification of pure cultures of bacteria is important. In these tests the bacteria are inoculated into a test-tube of broth or peptone-water containing the carbohydrate to be tested and an indicator such as phenol red. During the growth of the organism if the carbohydrate is fermented (*i.e.*, acid is produced) the indicator changes colour. Since the conditions in the medium are not fully anærobic part of the acid accumulating may be oxidised by molecular oxygen. If the rate of attack of the carbohydrate is slow while the rate of oxidation of the intermediate organic acid is faster no fermentation reaction will be recorded. Lactic and acetic acids which are most likely to be formed as intermediates are oxidised much more rapidly by the plague bacillus than the pentose sugars.[1] This may explain the discordant results obtained by different workers on the fermentation of arabinose, rhamnose, xylose, dulcitol, etc., by the plague bacillus.

M. Sadashiva Rao.

Haffkine Institute,
Parel, Bombay,
November 28, 1940.

1 M. S. Rao, *Ind. Jour. Med. Res.*, 1939, **27**, 617.
2 —, *Ibid.*, 1940, **27**, 833.

Water Pollution by Distillery Waste

It is observed that when a distillery waste mixes with a river or other flowing water, an offensive smell develops in the lower reaches of the water. A sample of the Halla water at Mandya into which the distillery spent wash flows, showed the presence of 3·4 parts of H_2S per 100,000 (by iodimetric estimation) with the accompanying odour after a storage of 5 days, whereas there was absence of the gas on the first day.

To determine the cause, the spent wash was analysed and gave sp. gr. 1·036/25° C., solids

on evaporation and drying at 100–110° C.—6·0 to 7·0 per cent.; ash—1·64 per cent.; yeast centrifuged 0·75 per cent.; potash 0·7 per cent.; sulphur, present in sulphate 0·098 to 0·13 per cent. The spent wash diluted 1 : 1 or 1 : 2 was clarified with 2 per cent. lime which precipitated most of the yeast and colloids. The precipitate dried at 110°–120° weighed 2·5 per cent. and the ash was 1·05 per cent. The dry precipitate on acidification with HCl gave off CO_2 and no H_2S. The clear filtrate passed through sand was not free of yeast, but when passed through a Seitz filter, was free from all yeast and bacteria. Solids on evaporation of the latter filtrate, dried at 110° C., weighed 4·8 per cent. of the spent wash and on acidification with HCl gave off H_2 and H_2S. Igniting the solids gave ash—1·6 per cent. in which Fe ·0008 per cent., CaO 0·83 per cent., K_2O 0·77 per cent., and sulphide, estimated by liberating H_2S and iodimetric titration, as S ·03 parts per 100,000 of the spent wash.

In practice, sulphitation cane molasses is diluted 1 : 5 with water and acidified with sulphuric acid to pH 4·5 and a vigorous stream of air passed through the liquid to ensure quick dilution. Calcium sulphite, $CaSO_3$, present in molasses is thereby converted to sulphate and much of the gas SO_2 escapes. After fermentation with *S. Cerevisiæ*, the wash is fed to the Analyser and steam is passed up the column. Alcohol vapours, with the small quantity of dissolved SO_2, pass to the Rectifier from the top of which uncondensed gases escape to the air. The spent wash leaves from the bottom of the Analyser. Daily a quantity of 25,000 gallons of spent wash flows into the Halla where it may be diluted with 200 to 300 times its volume of canal water. The quantity of water flowing in the Halla varies greatly with the season and the offensive odour is either strong or negligible accordingly.

The detection of sulphide in the spent wash lends support to the observation by Tanner[1] of sulphate reduction by the reducing enzymes in yeast. A further interesting observation was made at Mandya when the top section of the Analyser colum was dismantled after five years' working. There were a few hundred grams of a pulpy black deposit on the plates above the feed plate. The deposit appeared like free carbon and easily dropped off the plates. It analysed Cu 66·5 per cent. and S 33·5 per cent. and is thus found to be Cupric sulphide. Apparently free H_2S liberated from the wash, reacting with the hot copper plates at 80°–85° C., produced the sulphide. This confirms the observation of sulphate reduction by the yeast reductase to hydrogen sulphide. Thus the yeast from the spent wash depositing in the watercourse, continues sulphate reduction with production of the offensive odour of H_2S, concentration of which depends on the quantity of water flowing in the Halla. Sulphur reducing bacteria are apparently a contributory cause as there is a development of odour when sulphite containing waste water from the factory is allowed to stand a few days.

To avoid water pollution by the gas, H_2S, the suggested measure is to remove the yeast, partly by centrifuging the wash before feeding into the still and then to precipitate the residual yeast in spent wash, with lime and subsequent filtration. The economy of this procedure has to be studied in each case.

Y. K. Raghunatha Rao.

Distillery,
Mysore Sugar Co., Ltd.,
Mandya,
November 12, 1940.

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1 Tanner, F. W., *J. Amer. Chem. Soc.*, 1918, **60**, 663.

[Since the above note was written the Analyser plates were taken out and it has been found that the comb-slit bubbling cups of three plates, directly above the feed plate, have been so much acted upon that the 3/12″ thick metal has become thin as paper and torn out of shape especially at the slit edges at which the hydrogen sulphide carrying alcohol-vapours turn down and bubble up through the condensed liquid. The copper sulphide deposits on the plates, which are comparatively uncorroded. The acids, in the vapours or entrained with the wash, including sulphuric acid, probably give rise to a soluble salt in contact with the hot

metal and then the copper sulphide is precipitated. This black precipitate is also found at the bottom plates of the Rectifier, and occasionally is drawn out with the lower oils. Y. K. R.]

The Influence of Light on the Germination of Species of *Striga*

SEVERAL workers have observed the high degree of variability exhibited by phanerogamic parasites and it would appear that species of *Striga* are no exception.

In the Botanical Section of the Poona Agricultural College, investigations upon three species of *Striga* that attack *jowar* (*Andropogon sorghum*) namely *S. lutea*, *S. densiflora* and *S. euphrasioides* have been in progress for some time. In the beginning, it was noticed that the first two species required the presence of the host for germination, whereas the third did not. In attempting to germinate the seeds of these three species in petri dishes exposed to light during daytime it was found that *S. lutea* showed some germination, *S. densiflora* gave very little germination and in the case of *S. euphrasioides* the percentage of germination was higher without than with the presence of the host. In order to induce better germination of *S. densiflora*, it was decided to try the effect of keeping the dishes in a dark chamber. Surprisingly, the result was that the seeds of the parasite showed a much higher percentage of germination when kept in darkness. The reaction of all the three species to light and darkness was, therefore, tested with still more interesting results. A typical set of results is tabulated below. The seed of a highly susceptible variety of Sorghum was used in the test.

Species	No. of dishes tested	Treatment	Percentage germination per dish	
			Range	Mean
S. lutea ..	50	Light	0–52	16·3
,, ..	50	Dark	0–73	38·4
S. densiflora ..	45	Light	0–11	1·5
,, ..	41	Dark	0–14·2	4·4
S. euphrasioides	50	Without host-Light	11·4–83·1	44·4
,, ..	50	With host-Light	0–64·3	32·6
,, ..	50	Without host-Dark	0–16·1	3·5
,, ..	50	With host-Dark	0–32·7	9·1

A word of explanation is perhaps necessary to account for the high range of variation in the results. This must be ascribed to three reasons (*a*) the progressive maturation of the seeds which is a characteristic of many of the phanerogamic parasites, (*b*) the inherent variation in the capacity of the host seed to induce germination of the parasite seeds, and (*c*) other causes controlling germination which have not been determined.

From the results it will be observed that *S. lutea* germinates about 100 per cent. better in the dark than in light. *S. densiflora* shows a higher percentage of germination in the dark though the germination is still unsatisfactory. In *S. euphrasioides*, the germination in the light is very much higher than in the dark; but whereas, with host, in the light a lower percentage of germination than without host is observed, in the dark the converse holds good.

It is not possible, at this stage, to explain this peculiar behaviour to light of the seeds of these three species of *Striga*, but it is hoped to throw more light on the problem as the work progresses.

The investigations were carried out under the grant sanctioned by the Imperial Council of Agricultural Research, Delhi.

L. S. S. KUMAR.
S. SOLOMON.

College of Agriculture,
Poona,
November 6, 1940.

Tetraploid Til (*Sesamum orientale* L.) from Colchicine Treatment

EXPERIMENTS for inducing polyploidy in Sesame (*Sesamum orientale* L.) by using colchicine have been in progress at the Oil Seeds Research Laboratory, Nagpur, since June 1938. After numerous trials we succeeded in obtaining a few tetraploid plants a short account of which is given here. A detailed account will appear elsewhere.

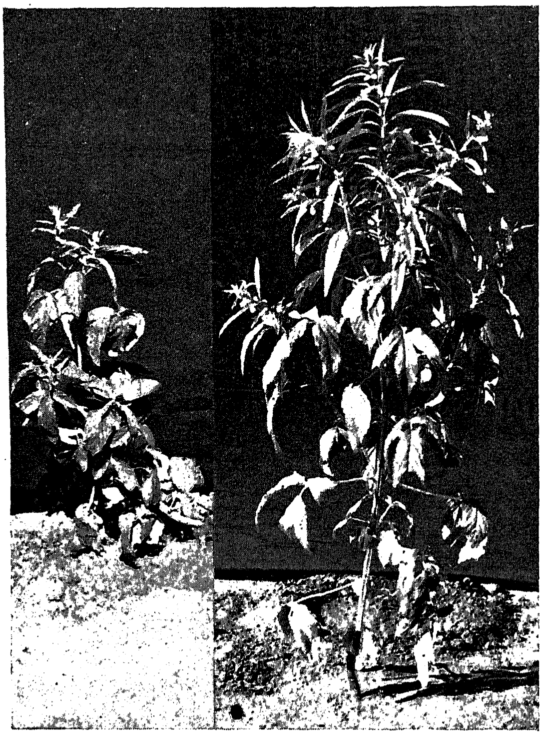

FIG. 2 Tetraploid Sesam — FIG. 1 Deploid Sesam

Three methods of treatments were used:—(1) Seeds were immersed in the colchicine solutions for different periods; (2) Seeds were allowed to germinate on blotting papers soaked in different concentrations of the solution; (3) Young flower buds were immersed into test tubes filled with different solutions for various periods. In all these experiments the materials were thoroughly washed after each treatment.

Seven abnormal plants out of a 100 seeds treated were noted only in the first treatment with 0·06 per cent. colchicine treated for 2 hours. These seedlings could be recognised by their swollen hypocotyls, thick cotyledonous leaves and short stunted roots. They developed into plants which appeared shorter, stiffer and thicker stemmed than the diploid. The leaves were coarse, dark-green, broad and thick.

Chromosome counts were made at meiosis from one of the plants only which has clearly demonstrated that it is a tetraploid with $n = 26$, the chromosome number in the diploid being $n = 13$. Being an auto-tetraploid 0–5 tetravalents are formed at meiosis.

R. H. RICHHARIA.
D. P. PERSAI.

Oil Seeds Research Laboratory,
Nagpur,
October 31, 1940.

The Inheritance and Linkage Affinities of the Yellow Coloured Midrib in Sorghum

THE colour of the midrib in sorghum is white if the stalk is pithy; it is dull green if th stalk is juicy. The former is a monogeni dominant to the latter.[2] The occurrence o midribs brownish purple in colour, due to th mechanical tissues being coloured brownis purple, has been recorded as a monogeni recessive.[3] The midrib could also be coloure yellow. Vinall, Stephens and Martin[5] recorde its occurrence among milos. In his tabulate list of sorghum characters Martin[1] has note the yellow midrib as dominant to non-yellow.

At the Millets Breeding Station, Coimbator it has been noted that this character of yello midrib occurs in 59 types. The distributic shows that it could occur in most variet groups. There is naturally a larger number i the groups with numerically more types, abo ten each in the three common species—*S. durr S. subglabrescens* and *S. nervosum*. Yello midribs occur in both pithy and juicy stalke varieties. Of the 59 types in which they we met with, it is noteworthy that 38 had blacki purple leaf-sheaths (PPqq).[4]

The yellow colour in the midrib is seen even in young plants a month old. It is prominent in the top leaves, and in the lower ones visible at the bases of the leaves. In full grown plants it is best seen in the top leaves at flowering time. If a leaf is cut and dried, the colour persists. The yellow colour is due to the presence of a carotinoid pigment in the sclerenchymatous tissues at the upper and lower surfaces of the midrib.

To study the inheritance of this character and its affinities to juiciness and leaf-sheath colour, crosses were made between two parents A.S. 3897 (yellow midrib, pithy stem and blackish purple leaf-sheath) and A.S. 3835 (dull green midrib, juicy stem and reddish purple leaf-sheath). The F_1 had yellow midrib, pithy stem and reddish purple leaf-sheath. In the F_2 generation four families were raised and the following segregation occurred:—

Stalk ..	Pithy		Juicy	
Midrib colour..	Yellow	Non-yellow	Yellow	Non-yellow
Total of 4 families	331	109	117	39
Calculated 9 : 3 : 3 : 1 :	335	112	112	37

It is evident that the above is a normal dihybrid distribution, the yellow midrib being independent of the stalk being pithy or juicy.

The segregations for leaf-sheath colour and yellow midrib colour pair of characters are given in the following table:—

Leaf sheath colour ..	Reddish purple		Blackish purple	
Midrib colour ..	Yellow	Non-yellow	Yollow	Non-yellow
A.S. 6558 ..	87	30	28	5
A.S. 6559 ..	87	36	37	4
A.S. 6560 .	73	31	27	4
A.S. 6561 ..	80	34	29	4
Total ..	327	131	121	17

It is obvious from the above figures that there has been a disturbance of the normal dihybrid segregation. Assuming linkage between the genes for yellow colour of the midrib and leaf-sheath colour, in the repulsion phase, a crossover value of 35·5 per cent. is obtained for the above distribution. The expected distribution on this assumption is as follows:—

Leaf sheath colour ..	Reddish purple		Blackish purple	
Midrib colour ..	Yellow	Non-yellow	Yellow	Non-yellow
Actual	327	131	121	17
Calculated (35·5% crossover)	317	130	130	19

$$X^2 = 1{\cdot}2, P > {\cdot}05.$$

To sum up: sorghums with midribs coloured yellow occur rarely in almost all varieties. The gene for this yellow colour has been designed Y_{md}. Y_{md} is a monogenic dominant to y_{md} (non-yellow). Y_{md} is independent of D, the gene for pithy stalk. It is linked with Q, the gene for reddish purple leaf-sheath colour, with a crossover percentage of 35·5.

G. N. Rangaswami Ayyangar.

M. A. Sankara Ayyar.

Agricultural Research Institute,
Coimbatore,
November 23, 1940.

[1] Martin, J. H., *U. S. Dept. Agric. Year Book*, 1936, p. 554.

[2] Rangaswami Ayyangar, G. N., *Madras Agric. Jour.*, 1935, **23**, 350.

[3] —, and Nambiar, A. K., *Indian J. Agric. Sci.*, 1936, **6**, 481.

[4] —, *et al.*, *Ibid.*, 1933, **3**, 589.

[5] Vinall, H. N., Stephens, J. C., and Martin, J. H., *U. S. Dept. Agric. Tech. Bull.* No. 506, 1936, p. 31.

Trichogramma minutum Riley, in Relation to *Sitotroga cerealella* Ol. in Mysore

Ever since the potentialities of *Trichogramma minutum Riley,* a well-known Hymenopterous egg-parasite, in the field of biological control of certain types of harmful insect pests of cultivated crops, were discovered, the eggs of the tiny grain moth, *Sitotroga cerealella* Ol. common over a large part of the world, have been in use, principally in U.S.A. for the mass rearing of the parasite in the laboratory before liberation of the latter in infested fields.

When experiments were first started in Bangalore about a decade ago to test the suitability of different insects, to act as laboratory hosts for the mass production of *Trichogramma minutum* Riley, found to parasitise the egg masses of the principal moth-borers of young sugarcane in Mysore State, the grain moth, *Sitotroga cerealella* Ol., was, for obvious reasons, one of the locally occurring insects whose eggs were exposed to the action of the parasite. It was found, at the time, that the parasite persistently refused to take to those eggs. It was not possible to explain this curious fact and further attempts were not made.

Attempts were, however, renewed recently, and now the parasite is found to accept the same host eggs that once proved to be unacceptable. Some 24 generations of the parasite were bred out of the eggs of *Sitotroga cerealella* deriving a slightly different biological strain of the parasite.

Before an explanation of this behaviour in host preference on the part of the indigenous race of the egg parasite, *Trichogramma minutum* Riley, is put forward, it is thought advisable to make further observations. In the meantime the fact that the eggs of *Sitotroga cerealella* Ol. were definitely acceptable here to the sugarcane moth-borer egg-parasite, for breeding and multiplication, on however small a scale, requires to be recorded.

Whether the same host eggs (*S. cerealella*) will serve in India, quite as well and on as large a scale, as in U.S.A. and other places, for purposes of mass production of the parasite and whether they can successfully compete with, or prove better than, the eggs of *Corcyra cephalonica* St. at present in extensive use, as the host, in the parasite laboratory at Mandya in Mysore State, is quite another matter, requiring further investigation.

B. Krishnamurti.

Department of Agriculture,
Bangalore,
November 20, 1940.

A Meteor

A most extraordinary meteorological phenomenon occurred at about 9-20 on the night of the 7th September 1940. A meteorite of unusual size and brilliance shot across the sky right overhead of us from east to west throwing out sparks of white light in profusion on either side of its dazzling trail, paling the electric lights all round for a few seconds. It appeared to come down in a big curve, and as it neared the horizon, its head turned reddish and the streak behind, bluish green. There was a thud like that of distant gunfire and a low roar for about a minute. The phenomenon was distinctly visible at several stations in the district, as I have been informed. Even people enjoying a circus show at Beawar, 32 miles S.W. of Ajmer, were attracted by this exciting object, and hundreds living in the open, in a Famine Relief Camp saw it. All declare that they never saw the like of it in all their life. Probably some of the villagers in Marwar living on the borders of Ajmer-Merwara, will be able to locate it.

A. N. David.

Husband Memorial High School,
Ajmer,
November 23, 1940.

REVIEWS

Concise General Astronomy. By O. R. Walkey and H. Subramania Aiyar. (Sridhara Printing House, Trivandrum), 1940. Pp. 442. Price Rs. 5–8–0.

Popular works on Astronomy published in India are very rare. Probably there is none. If so the present work is a pioneer in the field, and is to be warmly welcomed on that account. Its special feature, and in our opinion, its most valuable feature is the very interesting information it contains about Hindu Astronomy, and the incorporation of this information in a general scheme gives one a proper perspective regarding the achievements of Hindu Astronomy. The first three appendices make, from this point of view, fascinating reading indeed.

The other appendices contain information on such diverse topics as Arabian, Chinese and Egyptian lunar mansions, sundial design and map-projections, all subjects of a practical interest. The several tables brought together in one place from a large number of sources and arranged in a definite order are bound to be of great value even to those who are not merely "laymen". It would have been better if the source of information had been indicated in each table, for in this rapidly growing subject new data supplant the old ones with astonishing quickness. One is, however, constrained to say that the star maps on pages 414 and 415 are very bad, indeed the second map definitely disfigures the page.

The book proper consists of twenty-seven chapters, three of an introductory and historical nature, nine devoted to the solar system and the remaining fifteen to the study of stellar systems. Four out of these fifteen chapters give descriptions of the several constellations, and will be found to be of great use to amateur sky-gazers. The authors have taken pains to be up-to-date in the information on the several topics dealt with in the book. As examples in point we might mention the Lyot device for solar coronal observations, the number of satellites of Jupiter, the elements of Pluto's orbit, the mention of supernovæ, galactic rotation, the local cluster, Trumpler's stars the physical constitution of planetary atmospheres and several other data regarding galactic and extra-galactic nebulæ and star clusters. The book is an accurate and reliable guide to the lay reader in understanding the great developments in Astronomy that have taken place in recent years on the observational side. The numerous facts and figures are arranged clearly and succinctly, and presented in a racy and vigorous style, highly reminiscent of a popular evening lecture.

This idea of the popular appeal has throughout been kept in the forefront in the book, but, we are afraid, it is a little overdone. One such instance is the rather too frequent reference to the Creator whose aid is invoked even on occasions when it is not quite imperative. Thus, for example, the authors remark on p. 205 that the source of stellar energy cannot be accounted for on any known laws, and one has only to acknowledge the direct interposition of the Creator. In view of the recent work of Bethe and Gamow on the nuclear theory of stellar energy, it is difficult to justify such a stand. Even from a general point of view, such an attitude spells an air of superficiality about it and appears out of place in a book which is entitled as a *Concise General Astronomy*, and which is scientifically accurate in the details of the subject it gives.

Nor are the references to the theory of relativity quite happy. It is unfortunate that the book should contain a sort of a contemptuous reference to the "mathematician's square-root-of-a-negative quantity and purely imaginary concept of some fourth or other inside-out dimensional existence", for this gives an entirely erroneous impression that the concept of time in relativity is purely imaginary. The reference to "a mathematical explanation of the sudden disappearances of angelic beings after delivering their messages" (p. 51) is unworthy of a place in a scientific book on general astronomy. Also the relativistic explanation in §295 of the meeting of two bodies as meaning the agreement in their space and time co-ordinates is definitely wrong since it contradicts the relativity of simultaneity as can be shown by considering the Lorentz transformation. We consider it an error of discrimination on the part of the authors to mention (p. 280) Sulaiman's

theory as an alternative to the theory of relativity without taking the trouble of examining the foundations of the former theory.

In the Preface to the book, we are duly warned against the "desertion of the standard of Science for the banner of speculation, often Science, falsely so called", and against placing implicit faith in Mathematics, the intellectual barrel-organ. We must, however, confess that the book itself abounds in speculation of a mystical nature. We must also protest against the book ending in a "Dream". The aim of a book on Astronomy ought to be the instilling of a scientific curiosity in the reader, and a wide-awakenness to the problems which still challenge a solution.

Apart from these criticisms of a general nature, we must admit that the book gives a valuable account of the advances in modern astronomy and is eminently readable. We wish it many more editions quite soon.

B. S. MADHAVA RAO.

Atoms in Action (The World of Creative Physics). By George Russell Harrison. (George Allen & Unwin, Ltd., London), 1940. Pp. 370. Price 12*sh*. 6*d*. net.

Much of the material presented in this book formed the basis of a series of Lowell Lectures entitled "Modern Physics and Human Welfare" given by Professor Russell in Boston. Some of his contributions to *The Atlantic Monthly, Harper's Magazine, The Scientific American* and the *Technology Review* have also been used in writing various chapters. When the American Institute of Physics suggested to Professor Russell the desirability of putting all these labours in the form of a book, it is no wonder that the author took nearly two and a half years in sifting and collating his material. The result is this fascinating book. As a physicist who has done considerable work in the field of spectrum photometry and spectrum analysis, he has presented in the book an extremely interesting picture of the diverse ways in which the recent advances in the world of atoms cross the paths of human civilization, in an easy style so as to be understood by the wider public interested in scientific themes.

The aim of the author in writing this book is set forth in these words "Almost every material problem of living turns out in the last analysis to be a problem of the control of energy. The wheels of civilization are kept turning by energy; and all this energy, whether we draw it from a gallon of gasolene, a ton of coal, or a pound of butter, has come to us from the sun. Energy is wealth, and in the case of apprenticed sunlight, wealth of a particularly desirable kind, for it is freshly created, free to him who can discover how to capture and control it". In the sixteen chapters of which the book is composed, the central theme "How energy is used" has been fairly comprehensively treated in practically every aspect in which man has utilised this "Spirit" of physical science. All the chapters have popular and arresting titles (Starting with "The Taming of Energy" to "The End is not Yet") and are provided with apt quotations somewhat in the Waverly fashion. It has the rich and wholesome atmosphere of a banquet about it, and the promised fare will satisfy the most epicurean appetite. The reader is taken through a wonderful field of the achievements of physics, which man has used for his cultural pleasure and material profit, and few readers will miss the delight of enjoying the vivid and impressive pictures portraying the power of the principles of physics in directing and controlling human activities. The chapters "The Ransomed Electron, Sound Borrows Wings, Eyes for the Memory and Sight Conquers Space" are of absorbing interest and the other chapters are written with the same clarifying force and imaginative insight. Those who wish for a generous and deeper understanding of some of the marvellous creations of science, Radio-telephony, Colour photography and so forth, will find in "Atoms in Action" every information they may desire. It is one of the very few books in its line, which is at once authoritative and entertaining, and in both respects, it constitutes a valuable contribution to modern scientific literature.

Chemistry, Life and Civilization (A Popular Account of Modern Advances in Chemistry). By Hubert T. S. Britton. (Chapman & Hall, London), 1940. Pp. vi + 266. Price 5*sh*.

This book is well written, well got up and well illustrated. The type is bold and gratifying to the eye. The matter dealt with, it need scarcely be said, is of vital importance. Human Society is at bottom chemical, and it progresses by the advancement of

researches in the physical sciences. There is hardly any phase of human activity,—politics and statistics excepted,—which has not been influenced and made better by the improvements in chemical technique and processes in industries.

The author has used an easy language and an elegant style in the presentation of the subject matter. For the benefit of those who may not possess a previous knowledge of chemistry, the general principles of the science are treated in a way which any intelligent person can easily follow. Having equipped the general reader with this preliminary acquaintance, the author takes him from Chapter VI on through a wonderland of achievements which have a tonicic effect on the intellectual appetite. Chemistry has added to the richness of the enjoyment of life, its gifts have also been prostituted, undermining the very civilization they have helped to build. Before the advent of science, the world was a great puzzle and the progress of scientific knowledge has solved a great many riddles and incidentally has materially tended to make life comfortable and civilized. The book reveals the processes by which human advancement has been accomplished, and should therefore present irresistible attraction not only to the inquisitive youngmen, but also to the older generation of the reading public, endowed with the spirit of enquiring into the "how" and "wherefore" of things by which they are surrounded. We have no doubt that there are few books in the field which offer so much interest and so much information as Professor Britton's work. There is a short supplement in which the author gives an account of the latest advances in our knowledge of vitamins, new drugs of the sulphanilamide group, protamine insulin, synthetic rubber, artificial wool and artificial silk. We have a fairly complete picture of the romance of chemistry in relation to human life and civilization.

Biology in the Making. By Emily Eveleth Snyder. (McGraw-Hill Publishing Co., Ltd., London), 1940. Pp. x + 519. Price 18 *sh.* net.

Undoubtedly students of General Biology and those of Medicine will be profoundly grateful to the author for placing in their hands a book at once eminently useful and extremely interesting. The author has adopted a new line of treatment. She has selected twenty-one biological topics practically covering the field of study pursued by medical students and others following a general course, and, under each subject, she has given a lucid description of the principal facts and short biographical sketches of the scientists who made the new discoveries, thus clothing the scientific treatise with a human interest. "The purpose of the book is to trace the development of biological discoveries, not as so many facts, but as the product of real men whose lives for one reason or another made them outstanding in other fields." The author has succeeded in her task, and the simple style she has adopted makes the reading of each chapter a matter of great pleasure. It must not be supposed, however, that the book attempts to exhaust the field, nor does each chapter comprehend all that could be said under each topic. For instance, the chapter on "Chemical Messengers" makes no reference to the pituitary gland to which, however, there is a passing reference in the chapter on Calories and Vitamins (p. 344); "Learning from Fossils": this is decidedly a poor and incomplete chapter; Cuvier and Agassiz have an interest, but the modern discoveries must have a deeper interest and significance to the study of biology. Consistent with the aim of the book, principally to serve the needs of students, the subjects are adequately and admirably treated. It follows the excellent traditions of modern scientific works in providing at the end of each chapter a list of other books for further reading, profuse illustrations of leading scientists, a general bibliography, glossary, chronological list of scientists, and an ample index. The book leaves nothing to be desired, and it will be widely welcomed not only by students, but by the general reading public. We congratulate the author and the publishers on this stimulating and interesting book, whose style is as attractive and simple as the matter dealt with is informing and useful.

A Text-Book on Crystal Physics. By W. A. Wooster. (Cambridge University Press, London), 1938. Pp. xxii + 295. Price 15*sh.*

The discovery of the diffraction of X-rays by crystals provided the physicist with a powerful method for the analysis of crystal structures, and during the last twenty-five years he has been accumulating, at a rapid

rate, data concerning crystal structures, of great importance to both Physics and Chemistry. While engaged in this new work it was only natural that other aspects of crystal work, as for example, the explanation of the various properties of crystals in terms of their fine structures as revealed by the X-ray studies, did not engage sufficiently the attention of the physicist. In some of the recent work on crystals, however, one can see a definite reaction against this over-much emphasis on structural problems, and a swing back of the pendulum towards problems concerning the real physics of crystals. As illustrations, we may refer to the detailed investigations both theoretical and experimental, that have been made on the optical, dielectric, magnetic, and other properties of simple ionic and molecular crystals, and on the properties of metals and alloys, in relation to their structures. The publication of Wooster's book is an expression of this swing back towards crystal physics, and to one who reads the book with the background of our accumulated knowledge of the results of the X-ray studies, the book serves as a gentle reminder of the neglect in which we have allowed the subject to remain.

Within the compass of less than 300 pages of large type, the author has managed to bring together the important results of crystal physics. The need for a book of this kind in English has indeed been felt for some time. A striking, and probably desirable, feature of the book is the use of the tensor notation throughout, which is very convenient in the treatment of the directional properties of crystals. The chapters on electric and magnetic induction, and on piezo-electricity, are well-written, and in particular the chapter on crystal optics, in which many little points that trouble the new-comer to the field, and are not properly dealt with in the ordinary text-books, are treated adequately. One wishes that an account had been included of the luminescence phenomena in crystals, which have been studied extensively during recent years. One also wishes that the diffraction of light by crystals in which are impressed ultrasonic waves, had been treated in greater detail, in relation to the determination of the elastic coefficients of the crystals, and a short account had been given of light-scattering in crystals. In the chapter on induction, though the diamagnetic crystals are treated at some length, the paramagnetic crystals are dismissed with just one paragraph. (The formulæ at the bottom of p. 100, and the statements immediately preceding them, are correct only when a_c is large. Quaterphenyl is misprinted twice as quarterphenyl.)

The publication of this book should be particularly welcome to Indian students, since no systematic teaching of crystal physics, as far as the reviewer is aware, is given in any of the Indian Universities.

K. S. KRISHNAN.

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1. **Poisons.** Their isolation and identification. By Frank Bamford. (J. & A. Churchill, Ltd., London), 1940. Pp. 344. Price 18*sh.*
2. **Forensic Chemistry.** By Henry T. F. Rhodes. (Chapman & Hall, Ltd., London), 1940. Pp. 214. Price 12*sh.* 6*d.*

Text-books on the subject of medico-legal chemistry are so rare that one welcomes any book bearing on the subject. The average chemist, who is engaged in detecting poisons for legal purposes is quite often driven to following a "hit or miss" method in the absence of adequate and accurate information regarding the mode of administration of poisons, the clinical and pathological symptoms and interval for such symptoms to appear, and the sequealæ-recovery, or death,—or other permanent residual effects, following the administration of such poisons. As is legally required in this country, the police subject all cases of suspicious death, (even paupers dead of starvation, accidental deaths, and all such cases where they feel that there is not sufficient evidence of the cause of death) to chemical examination; this necessitates the undertaking of expensive time-consuming analyses. Any relief or short cut given in this direction is very welcome indeed. The above two books cannot be said to give all the necessary and available information but represent two distinct approaches to the rather vague and ill-defined subject of Forensic Chemistry, and are in a sense supplementary to each other; both the books have made available information not always readily obtainable. One, however, longs for a complete modern text-book on the subject of medicolegal chemistry, but, this as yet is not to be!

1. Bamford's book comes well recommended. Prof. Sydney Smith, who will be

remembered by all the older medical men of this country, who have taken their final medical examinations at Edinburgh, writes a foreword to the book.

The book begins with a section on the practical equipment of a medicolegal laboratory. A considerable portion of the book is devoted to the detection of inorganic and metallic poisons. While this is in no way very new, and can be readily obtained from a standard modern text-book on Inorganic Analytical Chemistry, it has included the detection of metallic poisons by colour reactions involving extremely minute quantities of such metals by reagents which have come into recent use.

An extremely useful feature of the book is the effort to systematise the analysis for the detection of the presence of alkaloidal poisons. The various alkaloids are well classified and the usual reactions given by them are listed so as to be easily available for reference. The most useful part of the book is the section on the Stas-Otto process so necessary to be carried out in all cases of suspected poisoning; in this process one seeks to extract as far as possible in an unchanged condition, the poison which caused death. The process is tedious and it is possible to miss the poison altogether, unless great care is taken at each stage of the process. Bamford seems to be thoroughly conversant with the process and the various mistakes that one is likely to commit; he has given a very lucid account of its involved technique; it is an eminently practical account and deserves to be memorised in all its details by every medico-legal chemist.

It is regrettable, however, that the book will have only a limited appeal to the Indian student, as the poisons common in India are not treated in any very great detail. Dhatura, one of the commonest poisons in India is shelved to a second place along with Atropa Belladonna; some of the very common abortifacients, used all over India are not mentioned at all. Opium, and all its derivatives have been treated with great care; the myth that Smyrna Opium and Indian Opium can be easily distinguished, is exploded. Hashish, possibly so commonly used in Egypt, has been given all the importance, the subject deserves. The toxalbumins derived from the various irritants, like castor seeds, etc., have been uncritically mentioned on the authority of the Madras Chemical Analyser's Report. The difficulty experienced by a chemist in the analysis of the contents of the alimentary system of a child, dead or suffering from an overdose of a purgative oil (commonly sold, under various trade names, in all bazaars), containing a number of substances, chief of which would be croton and castor oils, along with various irritants like aloes, etc., is so great, that it is not possible to distinguish, much less easy to estimate, the number of substances present or to certify as to which was the essential irritant factor; nor can much information be derived regarding such irritants by the performance of the agglutination test, as given in the text (details of which have been very meagerly given). The habit of betel chewing is discussed with the usual good-natured contempt of a habit to which a westerner is not accustomed. There is a great amount of misunderstanding about this rather pleasant æsthetic habit; the average easterner eats a good deal of soft food which he swallows without much mastication; the spices mixed with arecanut produce enough salivation to mix with the food in the stomach; soft food leaves residues in the crevices of the teeth which later undergo decomposition and produce halitosis (fetor about the mouth), betel nut chewing removes the soft residues; this habit also allows of a greater amount of calcium intake (most of which is excreted). One cannot, however, speak with enthusiasm on the indulgence of this habit at all times of the day, with or without tobacco. (Oral cancer has been attributed to the irritant action of calcium.) The unpleasant symptoms associated with arecanut alkaloid is only with reference to uncured nut and not with boiled well prepared nut.

The section of glycosides may well be enlarged in the next edition, specially with reference to the obtaining of active principles from the gummy residues obtained towards the end the Stas-Otto process; this has always been a great difficulty in the path of the chemist. A section on animal experimentation with the poisons isolated, may well be added to the book to make it more useful. The book has a very good author index as also a good subject index.

2. Rhodes's book on FORENSIC CHEMISTRY contains an extremely useful section on stains and how to identify them; details regarding technique to be adopted in individual cases are also given; but the examination of seminal stains is dismissed rather summarily.

No other book has given such a wealth of detail regarding the examination of inks, both writing and printing inks. The importance of this information so well gathered together, can only be realised by a chemist who has to examine forged notes or cheques or questionable legal documents. Chemical examination of paper, chemical examination of inks, so many of which are available in the market, the pH of ink, age changes produced in ink by oxidative processes have all been well discussed that one is very grateful to the author for making such information available to the chemist. Unfortunately no one seems to have, as yet, handled the subject of inks prepared from vegetable sources, and the changes produced on them by age, chemicals, etc. This would be very useful in India where vegetable inks are used even now in rural parts. The section on counterfeit money is good and will be found useful by those who have to perform such analyses.

Chapter eight of the book consists of the examination of toxic agents. In forty-six pages the author has tried to give succinct information on toxicological chemistry. This portion of the book might well have been omitted, the author merely referring us to other books for such information, instead of treating the subject so perfunctorily. He might have, on the other hand, tabulated all the available information as he has tried to do in the earlier portions of the book, thus enlarging as also making the book more useful and complete.

The book gives more than a hundred and twenty references to original sources of information. An author index and a subject index have also been appended, making it easy for reference.

These books, being published as they are during war time, are priced quite cheaply.

ENNE.

The Scientific Principles of Plant Protection. By Hubert Martin. (Edward Arnold & Co., London), 1940. Pp. vii + 385. Price 22*sh.* 6*d.*

This book was first published in 1928; the present edition appears only four years after the second edition and, while following its plan, includes a discussion of the many recent developments in ways and means of controlling pests and diseases of crop-plants. Its object is to present to the entomologist and the mycologist a detailed survey of the physico-chemical factors underlying modern control methods, and to provide the chemist and the physicist with a means of approach to the biological side, thereby promoting co-operation between workers in these various fields.

A large part of the book, roughly two-thirds, is devoted to fungicides and insecticides, fumigants, methods of treating soil and killing weeds, the toxic action and chemical constitution of substances employed in plant protection and the like. The smaller part discusses the question of plant-resistance and the influence of external factors on the susceptibility of the plant to attack, the problems of biological control and the chemistry and tropisms involved in traps and baits; there is a final chapter on the treatment of the centres and vectors of infection. Emphasis has been given to the physico-chemical aspects of plant-protection because those who have to advise on its practical problems are primarily trained biologists, but, as the author himself recognises, this emphasis does not imply the greater importance of chemical over biological and cultural methods of control.

The data that Dr. Martin has extracted from his wide survey of the literature of crop-protection have been concentrated with a most economical use of words and arranged in short sections each of which is followed by a list of references. There is a good subject index which is an essential adjunct to a work of this type, there are no illustrations.

For those engaged in extending the use of insecticides and fungicides in India and in working on indigenous sources of toxic materials, the revised edition of this book will be most welcome; it will prove to be as useful to the one who has access to a well-stocked library as to another who is almost entirely deprived of these facilities. Possibly some of the terser abstracts may not be easy reading, *e.g.*, Arsenicals "induce an inactivation of the oxidising enzyme perhaps by an interference with the normal functioning of glutathione in the oxidation-reduction phenomena of the cell tissue" (p. 162), or "the bridging species serves to fractionate an initial mixture of biologic forms" (p. 331); but nevertheless they make far less demands on the time of the reader than do the orignal articles.

The new edition contains much new material and the old text has been drastically pruned and reset; it should be obtained by all who need to keep up to date in a field where methods are embarrassingly many and varied.

C. F. C. BEESON.

Organisers and Genes. By C. H. Waddington. (Cambridge University Press, London), 1940. Pp. x + 160. Price 12*sh.* 6*d.*

The author who is well known for his contributions in the field of genetics and of experimental embryology attempts in this book to bring about a synthesis between these two divergent fields of study. 'The discovery of genetic factors reveals only the first line of a chain of causal events whose other end, the adult character, is known, but whose intermediate links require elucidation. The genes cannot be regarded as immediately effective in causing the successive processes of differentiation, although they are undoubtedly the fundamental elements which ultimately control them.' On the other hand, Spemann's theory of organisers founded on experimental data and supported since by a large number of investigations in the field of experimental embryology, provides the 'causal network' underlying the processes of differentiation.

After setting the problem in the first chapter, the author deals in the next few chapters with relevant problems and questions raised by the results of experimental investigations on organisers. Chapters VI and VII deal with, for an ordinary biologist, abstruse investigations on genic actions and gene reactions. In the next chapters are discussed, first, the processes which lead to the establishment of chemical differences between the various organs within the organiser; then, are considered the chemical differences produced by induction; and finally, the problems of the development of morphological patterns are dealt with. In the last chapter (Chapter XII) the new concepts of 'fields' and 'levels of organisation' in developmental processes are discussed.

The book is highly stimulating and will prove of immense value to investigators in these fields. To the student, it summarises our knowledge, up-to-date, of organisers and of genes in relation to development.

S. G. M. R.

Grassland Investigations in Australia. (Imperial Bureau of Pastures and Forage Crops, Aberystwyth, Wales, Herbage publication series, *Bulletin* No. 29), 1940. Pp. 106. Price 5*sh.*

In reviewing *Bulletin* No. 26 on "Research on Grassland: Forage Crops and the Conservation of Vegetation in the United States" (this *Journal,* 1940, 9, 192), attention was drawn to the immensity of the problem of improvement of the world's grasslands. It was pointed out that one *Bulletin* (No. 14) was issued in 1934 dealing with the work on grasslands in Australia. The publication of another *Bulletin* on Australian work, within the short interval of six years, points to the great importance that is given to this problem in that country. It shows one more thing: that an agricultural country like Australia has not only taken advantage of the recent developments but has gone further at a rapid space to increase her livestock and dairy industries on which her prosperity depends. This is fully borne out by the increase in the imports of dairy products from Australia into India. It is a sad commentary on conditions in this country that under similar conditions and with a greater and faster increasing human and cattle population than that of Australia, no co-ordinated effort is yet made to encourage research on grasslands.

The great advance made in Australia in the improvement of its grasslands is all the more surprising when one bears in mind the fact that though it is larger by one-third than India, the net area of land available for pasture improvement is not more than half a million square miles or approximately one-sixth of the total area of Australia. The question that arises in one's mind is: How then has Australia attained its present position? Intensive research by about 15 institutes and commercial companies whose programmes are controlled by a Central Body—the Division of Plant Industry of the Council for Scientific and Industrial Research—has rendered possible this phenomenal progress.

Before undertaking pasture improvement, several surveys were carried out: (1) Soil survey by Prescott: this revealed that the podsol and red-brown earths were deficient in phosphate and nitrogen and emphasised the necessity for using phosphatic fertilizers and the cultivation of clover on these soils; (2) a survey of the density and type of

stock population of Australia; this served to mark out the regions requiring concentrated attention; (3) a survey of the types of grasslands in the northern semi-arid areas: this revealed the variations in grasses according to topographical, geographical and climatic conditions.

It may be mentioned here that one important feature of the work of the Division of Plant Industry relates to the irrigation of pastures. Nearly three quarter of a million acres of low carrying pastoral land have been brought under intensive production as a result of irrigation.

The importance of a survey of the grasslands of India as suggested by the reviewer in 1938 (this *Journal*, 1938, **6**, 600) will be readily appreciated. It is hoped that such a survey would be taken up in the near future as it would point the way for the proper utilization of about 25 per cent. of the cultivable waste lands of India.

F. R. BHARUCHA.

THE INVERTEBRATES

The Invertebrates: Protozoa through Ctenophora. By Libbie Henrietta Hyman. (McGraw-Hill Publishing Co., Ltd., London). Pp. xii + 726. Price 36*sh.*

A TEACHER in Zoology for advanced classes often wishes with a sigh that somebody in the English-speaking world got busy to give him a book in English comparable with the German treatises, Kukenthal-Krumbach's *Handbuch der Zoologie* and Bronn's *Klassen und Ordnungen des Tierreichs*. The obvious reason for the absence of such a book in English appears to be that generally we fight shy of a bulky book. But it also appears impossible to avoid the use of large and voluminous tomes in higher zoological teaching. All over the world fresh light is being thrown on old problems, new problems have come to being and generally, new concepts and ideas are constantly taking the place of older ones so that Zoological teaching would cease to be the useful thing it is, if it did not keep abreast with the times. Two very different kinds of scientists bend their energies to the production of apparently two different kinds of results. First, there is the researcher who is interested in tackling new problems. And there is the other kind of worker, who is constantly co-ordinating the results of the researcher and making them available in an easily assimilable form to the student. Generally, seeing how arduous the latter task is, but how less intellectual, many are drawn away from it. Its importance is nonetheless to be admitted, for the original investigations of the brilliant researcher would otherwise be lost in the oblivion of the musty tomes of Zoological journals if they were not resurrected and reshaped to the needs of the student and placed within his reach.

It is staggering to think that it is nearly forty years since an exhaustive treatise on invertebrates appeared in English. It is sad to contemplate that during this long period Zoological teaching did not advance a step further, only because Zoological research was not correlated with Zoological teaching. In 1939 much of what was taught to the classes was based on what was found in Lankester's Treatise (which was never completed) and which was published 39 years ago. It was not because Zoological knowledge had not been furthered but only because this knowledge had not been brought within the reach of the Zoology teacher. This task, evidently a stupendous one, has just been undertaken by L. H. Hyman whose book under review forms the first part of the first volume of a series of three volumes planned for invertebrates.

We recently had an opportunity of reviewing another new book on invertebrates (Parker & Haswell's *Text Book of Zoology*, Vol. I, in *Current Science*, Sept. 1940) where the type method of treatment was employed and we felt that that method though advantageous to the beginner was full of defects where higher Zoological teaching was concerned. Dr. Hyman recognises them and adheres to the description of the phylum, emphasising the numerous morphological variations met with in it, a method which the reviewer feels is the most suitable for the needs of the advanced student. Likewise, elaborate descriptions of parasitic forms have been omitted. Parasites have recently come into their own,

and treatises dealing exclusively with them have appeared in large numbers. Elaborate schemes of classification, phylogeny and palæontology also have no place in a purely morphological treatise and so have been given but brief consideration.

The first two chapters deal with the general principles of Biology, like the structure of the cell, the protoplasm, and the principles of Zoological classification. The third chapter deals with the Protozoa. It is impossible to give an adequate account of this group of animals within the space of less than 200 pages allotted to it. But the author has endeavoured to incorporate much of the more recent knowledge on the structure and bionomics of Protozoa. It is refreshing to see, in the short space available, the correction of many erroneous beliefs regarding the physiology of the group. An instance in point is the contractile vacuole, which, in the older text-books was described as performing an excretory function, and which later work has proved to be more or less incorrect, substituting a mere osmoregulatory function to this organelle. The neuromotor system of the Protozoa is another aspect of recent research and Dr. Hyman has condensed much of our knowledge, and with the help of beautiful illustrations, has given a fair summary of the structure of the neuromotor organs.

The Mesozoa are considered next, evidently because, though diplobastic like sponges and Cœlenterates, the second layer in these animals does no digestive function and so is probably not homologous with the similar layer in sponges and Cœlenterata. But the apparent simplicity of organisation might in reality be a result of degeneration, for these animals are all endoparasites. However, the anomalous position of this group has been so unsatisfactory that the author thinks it a better plan to place this group, at least provisionally, between the Protozoa and the Metazoa. An illuminating chapter on the general characters of the Metazoa follows, which includes a brilliant analysis of Haeckel's Recapitulation Theory and the bearing of the recent work of Sewertzoff on the problem.

The Porifera occupy a peculiar position in the animal series. Their organisation clearly indicates a very low metazoan place for them. Their highly developed and varied skeleton, their peculiar choanocytes and their unique physiology lead us to conclude, with the author, that the Phylum Porifera "is obviously a blind branch of the animal kingdom that has no direct relationship to the Eumetazoa".

The rest of the book, nearly half of it, is devoted to a consideration of the Cœlenterata. The author, though not opposed to the usage of the term Cœlenterata, does not employ it as frequently and as freely as the previous writers on invertebrates have done, and prefers to follow Hatschek by dividing it into Cnidaria and Ctenophora, and elevating the latter to the rank of a distinct phylum.. While this is admissible on some grounds, such as the absence of the nematocysts in Ctenophora, there is no doubt whatsoever that the Ctenophora are most nearly related to the Cnidaria, as the author herself admits. The resemblances are far too many and too striking to be overlooked, and many of the differences are either too insignificant or are due to an advanced organisation and the different habits of Ctenophora.

Throughout the book the treatment of the subject indicates a happy blend of comprehensiveness and clarity and the beautiful illustrations,—all of them line drawings—make the book doubly attractive and useful. If the others in the series follow the same plan of treatment and format as this one, we might safely prophesy that it will be the most useful text-book on invertebrates to the student. B. R. S.

THE CENTRAL REVENUES CONTROL LABORATORY NEW DELHI

BY

H. B. DUNNICLIFF, C.I.E.

(Chief Chemist, Central Revenues, Government of India)

THE first chemical work done in connection with the assessment of sea-borne imports to duty was in the determination of the spirit strengths of potable liquors in the Gauging Departments of Custom Houses. In the first instance, all customs duties were assessed on a flat *ad valorem* basis and the administration of this tax did not involve the chemical examination of goods other than spirituous liquors.

Gradually, however, variations arose in the rates of duty on different classes of articles and, in many cases, within those classes on the types and grades of manufactures as indicated by percentage composition, instances of which in the current schedule are mixed textiles, paper, paints, dyes, petroleum products, condensed milks, chemicals, cements, certain articles containing precious metals and many others.

World progress in industrial chemistry resulted in the manufacture of many important commodities frequently marketed under fanciful and often misleading trade names. The range of goods of this kind covers an immense field of utility and is consequently on the increase.

The examination of such synthetic compounds or mixtures in order to determine their allocation to the correct item in the Indian Customs Tariff for assessment to duty calls for much analytical skill and resource. A study of the tariff will show that more than half the classes of import mentioned are susceptible to chemical examination in connection with their assessment, and the amount of revenue involved is very large. The increase in the number of headings and sub-headings in the Tariff was gradual in its progress but cumulatively very considerable and ultimately introduced the necessity for the creation of some regular and reliable agency for chemical testing of many articles at the principal sea ports.

In 1912, a combined Customs and Excise Laboratory was set up in the Calcutta Custom House but analytical work at the other major ports of Bombay, Karachi, Madras and Rangoon was carried out by the Chemical Examiner to the Local Government on payment. After some years, however, it was found that this arrangement was not working very satisfactorily mainly because of the increasing number of samples sent for test and the unavoidable delays involved thereby and on account of the distance of the Local Governments' Laboratories from the Custom Houses.

As a result of a careful review of the whole subject it was decided in 1926 that the work of examining samples could be more expeditiously carried out at less expense to the Central Government, if suitable laboratories were equipped and staffed in the Custom Houses themselves. In this way delays annoying to importers would be avoided and there would be the additional advantage that the Laboratories, like other departments of the Custom House, would be under the direct administrative control of the Collector of Customs.

Laboratories provided with certain essential apparatus and chemicals from Calcutta were first opened at Rangoon and Karachi but the equipment and staff were inadequate and it was decided that a specialist officer must be appointed to put the organisation of the existing laboratories on a sound footing and open up similar analytical departments in the Custom Houses at Bombay and Madras.

In 1928, the Government of India [illegible] the Chemical Examiner for Customs and Excise at Calcutta, Mr R. L. Jen[illegible]

undertake this development and to standardise the methods of analysis to be adopted at all ports. Unfortunately, in the July of that year, Mr. Jenks fell seriously ill and had to proceed at once to England.

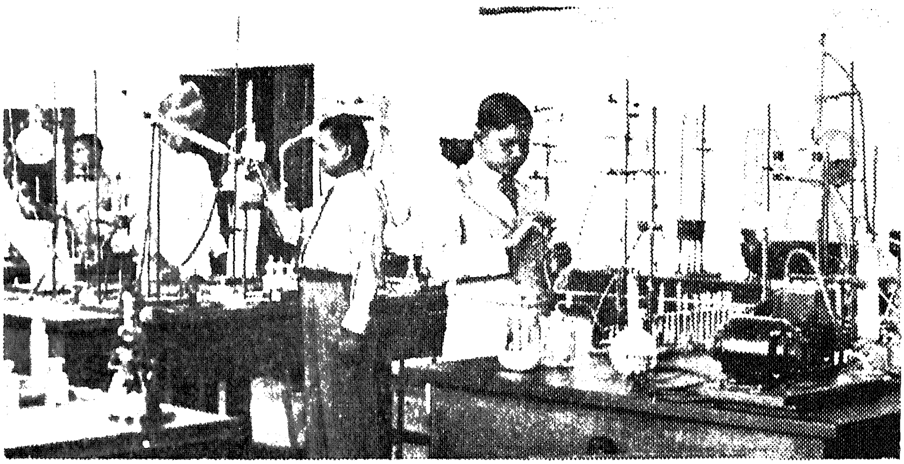
The following October, the author was appointed Special Chemical Adviser (Customs) to the Central Board of Revenue and the four new laboratories were in operation by April 1st, 1929, although the equipment and staff was not complete in all cases.

PROPOSAL FOR A CONTROL LABORATORY

An integral factor of the scheme for the administration of these laboratories was the inauguration of a Central Control Laboratory, the functions of which would be to deal with technical matters such as the standardisation of analytical methods, the issue of instructions for the testing of goods presenting special difficulties, the investigation of chemical problems arising at the port laboratories and the re-examination of samples relevant to cases in which the importer had appealed against the assessment of the Collector at the port. It was also necessary to have an independent laboratory at which a selection of routine samples from each laboratory could be examined periodically by competent chemists to make sure that the standards and methods used at port laboratories were efficient and identical. There was also a demand for a technical advisory officer to whom questions of a scientific nature from the Central Board of Revenue and, incidentally, miscellaneous chemical problems from other Government Departments could be addressed.

This scheme, though accepted in principle, was to be tried out experimentally before embarking on the building and equipment of a Control Laboratory.

Arrangements were, therefore, made with the Punjab Government for the Control Laboratory to be accommodated temporarily in the Chemistry Department of the Government College, Lahore. A small staff was appointed under the administrative and technical control of the author who undertook the part-time appointment of Special Chemical Adviser to the Central Board of Revenue in addition to his post as Professor of Chemistry in the College.



The Main Laboratory

The scope of the scientific responsibilities of the Special Chemical Adviser increased progressively, first opium, then salt advisory and investigation work being added to his duties for Custom Houses. Further demands were made on the services of the Control Laboratory from time to time and it eventually became obvious that there was too much work for a part-time Chemical Adviser and the small staff and restricted facilities at Lahore. As a result, it was decided that certain of the functions which the scheme proposed should be served at the central laboratory should be undertaken elsewhere until the Control Laboratory was placed on an individual footing.

Accordingly, to the Calcutta Custom House were assigned the purification of contraband cocaine by a chemist trained at Lahore and

the newly devised co-ordination scheme for testing potable spirits and spirituous and medicinal preparations, while the standardisation of hydrometers and certain excise work already being done there for certain Indian States, Local Governments and Centrally Administered Areas and intended ultimately to be moved to the Centre, remained undisturbed. To Bombay was given the co-ordination schemes for restricting the testing of dyes, mineral greases, lubricating oils and certain other petroleum products.

After this modified scheme had operated for about six years, during which the Customs and Opium Chemical Service had come into being, the Government of India decided on the appointment of a full-time Chemical Adviser and the construction of a separate building for the Central Revenues Control Laboratory. The question arose as to where this central laboratory could be most suitably located.

From the first, the general view was that it was undesirable that the Control Laboratory should be accommodated in any of the Custom Houses as it was considered inexpedient that control work should be carried on in immediate association with the routine analytical work at any one of the Board's laboratories. From an administrative standpoint also it was agreed that a place nearer the Government of India headquarters would be most suitable.

A suggestion that, by arrangement with the University of the Punjab, the Control Laboratory should be accommodated in the University Laboratories was rejected after considering all the implications of the proposal.

Similarly, in connection with the construction of a new Custom House at Calcutta, it was originally proposed to house the Control Laboratory in that building but this scheme was eventually dropped in favour of a more central site at Delhi.

Delhi Chosen for the Control Laboratory

The final decision followed upon a national calamity, the Bihar earthquake of 1934.

When, as a result of the damage caused to the Pusa Laboratories by that disaster, it was decided to transfer the Imperial Agricultural Research Institute to the present site at New Delhi, it was felt that, without inconvenience to the Institute, the Control Laboratory of the Central Board of Revenue could be built within its precincts. It was considered that it would be mutually beneficial to have such scientific departments near each other and that, apart from technical advantages, it would avoid duplication in the cost of some essential expensive services such as gas manufacture, high pressure water supply, electricity mains and sewerage. Furthermore, certain departments of the two institutions could be mutually helpful, as, for example, the library, the constant temperature rooms, the store room for dangerous petroleum and other inflammable solvents, safe deposit facilities and the use of certain expensive apparatus.

The proposal was accepted in principle in 1935 and, at a cost of about Rs. 5,000, the capacity of the gas-plant of the Institute was increased to meet the future requirements of the Control Laboratory but, though the site for the Central Revenues Laboratory was reserved, financial considerations prevented further immediate action.

The Laboratory, its Staff and Equipment

In 1938, however, the Government of India decided to put into execution the plan for the construction and equipment of the laboratory.

The sanctioned cost of the building and equipment was as follows:—

Construction of the Laboratory including electrical equipment, sanitation, etc.	Rs. 47,400
Construction of Chemical Examiner's bungalow staff, garage and cycle shed, godown and inferior servants' quarters	,, 24,600
Portable furniture and laboratory benches, etc., involving the incorporation of gas and water supply; gas supply, water supply, workshop tools, picture rails, etc.	,, 25,240
Apparatus and Chemicals ..	,, 23,000
Books	,, 3,000
Gold-plating plant	,, 970
	Rs. 1,24,210
Addition to gas plant ..	,, 5,000
	Rs. 1,29,210

The accommodation comprises a large general laboratory (41′ 0″ × 30′), a smaller laboratory (33′ × 19′) mainly devoted to excise work and standardisation of instruments, a combined office and laboratory (17′ 9″ × 19′) for the Chief Chemist, a dark room (16′ 6″ × 8′), a combined balance and precision instrument room (20′ 6″ × 12′ 3″), a furnace room (19′ × 11′), a rest room (20′ 6″ × 16′) which being suitably fitted can, when necessary, be also used for testing explosives as it is correctly lighted

and free from any risk of fumes, a combined library and museum (29′ 7½″ × 20′ 6″), an office (25′ 9″ × 20′ 6″) and a workshop (15′ 6″ × 20′ 6″) together with the necessary lavatories and store-rooms for apparatus, chemicals, records and remnant samples.

The workshop is equipped with an electric lathe, a drilling machine, a forge, a carpenter's bench, a gold-plating plant and buffing and polishing machines.

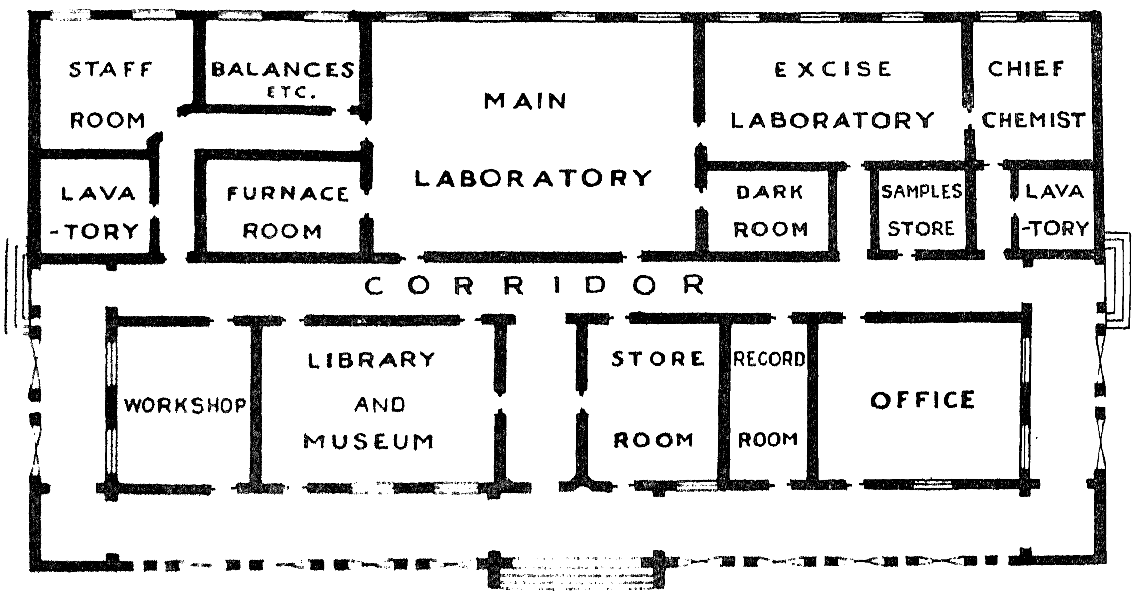
The walls have been provided with chases for air-conditioning and it is hoped that, as the laboratory will operate throughout the year, this desirable amenity will be supplied before next hot weather.

The general arrangement of the rooms is shown in the line plan.

The building, furnishing and installation of essential services were completed by the Central Public Works Department in October, 1939 and the laboratory was taken into service from November 9th of the same year, a start in the experimental work being made with such apparatus as was brought from Lahore augmented by purchases from Calcutta and elsewhere as, owing to the war, the greater part of the apparatus and chemicals from Europe and America had not been received.

The apparatus for the purification of contraband cocaine and the excise work done by the Calcutta laboratory was taken to Delhi early in December together with the relevant records.

CENTRAL REVENUES CONTROL LABORATORY
NEW DELHI.



SCALE 1″=24′

The air-conditioning plant will be placed at the west end of the building while an impression of the exterior of the building, the back of which faces due north, and the main laboratory can be obtained from the photographs published by the courtesy of *The Statesman*.

Owing to the limited space available, a residence was not provided for the Chief Chemist nor the majority of his scientific and ministerial staff. A suitable bungalow has, however, been built near the laboratory for the Chemical Examiner and a number of quarters for inferior staff.

The Control Laboratory Staff

The entire staff was transferred from Lahore and the Assistant Chemical Examiner and a Chemical Assistant from Calcutta, the rest of the sanctioned establishment being appointed by direct recruitment.

The personnel is as follows:—

The Chief Chemist, Central Revenues, who is also Director of the Control Laboratory.

The Chemical Examiner (Grade I), Central Revenues Control Laboratory.

The Assistant Chemical Examiner, Central Revenues Control Laboratory.

One Chemical Assistant (Grade I) (Rs. 300–20–400) and, including one chemist for the Central Excises and Salt Department.

Three Chemical Assistants (Rs. 150-10-250-E.B.-10-300).

In addition, the laboratory is available for use by the technical staff of the Central Excises and Salt Department as occasion requires.

The three officers first named are members of the recently constituted Central Revenues Chemical Service (see Note*), a Central Service, Class I.

The Chief Chemist is an *ex-officio* member of the Technical Advisory Board constituted under the Drugs Act of 1940 and the present incumbent of the post is a member of the Drugs Supply Advisory Committee and also Chairman of the Salts Committee of the Department of Scientific and Industrial Research.

Altogether, thirty chemists are employed in the laboratories maintained by the Central Board of Revenue at Bombay, Calcutta, New Delhi, Ghazipur, Karachi and Madras.

At the Control Laboratory, there is an instrument maker and a head laboratory attender and store-keeper while each chemist is allowed one laboratory attender to assist him in chemical operations.

The ministerial staff consists of an office superintendent, a stenographer, one upper division clerk and four lower division clerks including one for Central Excises and Salt. Adequate inferior staff has also been provided.

THE DUTIES OF THE CONTROL LABORATORY

As has been shown above, the chemical work from which this expanded scheme and the construction of the Control Laboratory arose dealt primarily with the examination of imported goods in order to ensure the correct assessment of the merchandise to customs duty. This is still the main function of the laboratories at the Custom Houses though they do other chemical work, such as the testing of explosives and petroleum products for Labour Department and foodstuffs for the Port Health Department, classification of oils for duty and railway freights and the examination of a variety of export samples under recent war legislation. Although many changes have occurred in the Indian Customs Tariff since the article was written, a very fair idea of the duties of the Custom House Laboratories can be gathered from the article "Chemistry in the Customs Department", published in *Current Science* of July 1935, pp. 42–46.

The duties contemplated for the Central Revenues Control Laboratory are also outlined in the earlier paragraphs of that article but, with the passage of time, the range of the analytical and advisory work expected of the department has expanded very materially. Thus, in addition to (*i*) the centralisation of the issue of standard lists of potable spirits and spirituous and medicinal preparations and of imported dyes, the object of which is to restrict the number of samples of these commodities sent for test, (*ii*) some general excise work, including chemical

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* The Central Revenues Chemical Service, a Central Service, Class I, is the youngest of the All-India Services. It was created by the Governor General-in-Council in 1937 under the designation "The Customs and Opium Chemical Service, Class I". When, subsequently, analytical and scientific advisory work for the Collectors of Central Excises and Salt were included in the duties assigned to the Service, it was re-named "The Central Revenues Chemical Service" in 1938 and the designation "Special Chemical Adviser", Central Board of Revenue" was changed to "Chief Chemist, Central Revenues".

The following ten posts are at present borne on the cadre of the Service. The grades of pay and headquarters of each officer are also shown,

Chief Chemist Central, Revenues (New Delhi).

Rs. 1,500–50–1,800 *plus* £ 30 sterling overseas pay if admissible.

Chemical Examiners, Grade I (4):

Rs. 600–40–1,000 for officers in the service before 1931 ;

Rs. 450–475 (on probation) 500–30–740–E.B.–35–950 for officers entering the service after 1931.

Chemical Examiner, Central Revenues Control Laboratory, New Delhi.

Chemical Examiner, Central Excises and Salt, Delhi.

Chemical Examiner, Custom House, Bombay.

Chemical Examiner, Custom House, Calcutta.

Chemical Examiners, Grade II (4):

Rs. 250–275 (on probation)–300–20–520–E.B.–550–30–700.

Chemical Examiner, Central Excises and Salt, North Eastern India, Calcutta.

Chemical Examiner, Custom House, Karachi.

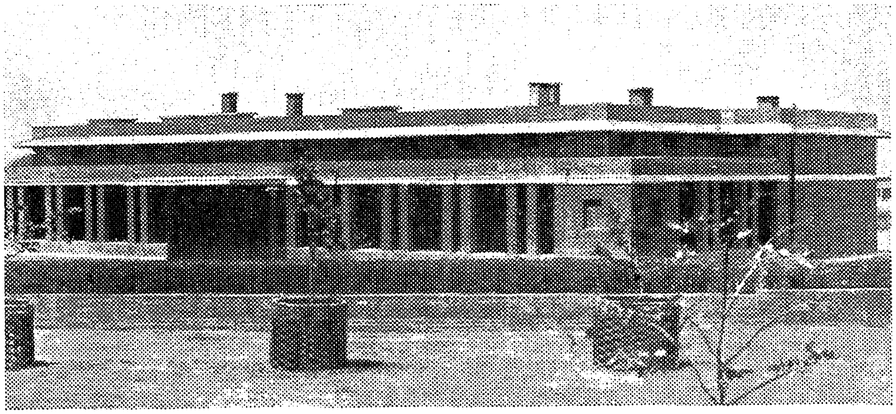
Chemical Examiner, Custom House, Madras.

Chemical Examiner, Opium Factory, Ghazipur.

Assistant Chemical Examiner, Central Revenues Control Laboratory, New Delhi :

Rs. 300–20–500.

examinations in certain classes of court cases and advice on problems connected with indigenous alcoholic preparations, etc., for a number of Indian States, Provincial Governments and Centrally Administered Areas, (*iii*) the purification of contraband cocaine for sale to Indian Medical Store Depots, (*iv*) appeal cases from Custom Houses and the Central Board of Revenue and (*v*) control analyses for the ports, the Central Revenues Control Laboratory serves a number of other functions of which the following will give some idea.



Central Revenues Control Laboratory, New Delhi

Hydrometers are standardised for the port laboratories and a gold-plating plant has been installed in the workshop for reconditioning brass instruments and balance-weights not otherwise damaged.

A number of laboratory investigations have been carried out in connection with the factory processes and the storage of opium at Ghazipur, such as the determination of oil in Malwa opium, the deterioration of opium on storage, the investigation of opium alkaloids and their derivatives used in medicine, *e.g.*, the manufacture of codeine, dionin, heroin and apomorphine, the possibility of the extraction of papaverine from marc of opium on a commercial basis and an attempt to separate opium into analysable fractions by the chromatographic method.

From time to time, technical notes are issued to port laboratories on the uniformity and standardisation of analytical methods on such diverse subjects as the determination of denaturants in imported spirits, the testing of kerosenes as regards their suitability as illuminants, the quantitative examination of paints, dyes, mixed fabrics, gold and silver plated articles, paper, extreme pressure lubricants, explosives, asphalts and refractories. A field of endless variety is the examination of imported preparations with fancy names in order to determine their description in terms of the Tariff, and sometimes to detect infringements of the Merchandise Marks Act.

Problems concerning various products in the sugar and nitre industries, the utilisation of bitterns salt from Sambhar in various manufactures, the examination of the East Lake salt deposits at Sambhar particularly with respect to the formation and amount of crystal salt available, the specification for marketable Khewra gypsum, the analyses of country-made soaps in connection with duty-free salt concessions, the denaturation of salt for various industrial purposes and the determination of these denaturants after admixture are among the types of scientific work conducted for the Collector of Central Excises and Salt, North Western India, in the Central Revenues Control Laboratory in New Delhi.

While research work, as such, is not a major function of the Control Laboratory, original papers have been published from time to time on chemical problems successfully investigated. Chemists at the Board's other laboratories also make occasional contributions to scientific journals though there is little opportunity for such work at the ports.

Occasionally, an analyst is trained for a

Provincial Government or for one of the Board's Laboratories.

A number of enquiries are received from various official sources, asking for technical advice, often requiring experimentation in the laboratory or in the design or equipment of laboratories and it has been possible, with the approval of the Board, to accept a limited amount of such consultative work.

Recently, in conformity with the decision taken at the Excise Commissioners' Conference, 1937, the Provinces requested the Central Board of Revenue to prepare a schedule of potable alcoholic medicinal preparations which might be used for other than medicinal purposes with a view to imposing a Provincial Excise Duty on such preparations higher than that levied on other spirituous medicines. The lists were prepared by the Chief Chemist after consulting a number of authorities and have been generally accepted by Provincial Governments and the Indian States.

There is also a considerable volume of work in connection with controversial cases, the revision of regulations and schedules of drugs, etc., and advice to the Central Board of Revenue on technical problems connected with Customs assessment, Central Excises problems and the Opium Factory at Ghazipur.

From the foregoing short account of its work, it will be seen that the functions of the Control Laboratory are very comprehensive. In addition to being Director of the Laboratory, the Chief Chemist visits the Custom Houses and the Opium Factory to inspect the laboratories and advise on their equipment and scientific work. He also visits the salt sources and sugar, leather and other factories, etc., in connection with the departments of Central Excises and Salt.

The Central Revenues Control Laboratory was opened by the Hon'ble Sir Jeremy Raisman, C.S.I., C.I.E., I.C.S., Finance Member to the Government of India, on April 5th, 1940, in the presence of a number of distinguished visitors.

SCIENCE AND INDIAN INDUSTRY

INDUSTRIAL researches, covering a wide range of technical and scientific subjects, are described in the Annual Report of the Industrial Research Bureau for the year 1939–40.

The research work of the Bureau, carried out by the Research Branch at the Government Test House, Calcutta, comprised work on the improvement of paints, the manufacture of efficient dry-cells, the utilisation of vegetable oils as lubricants or fuels in internal combustion engines, investigations to aid the glass industry, and many other items of practical industrial value.

A wide range of industrial information was collected and supplied to private concerns, individuals, and Government departments. The Bureau also published a series of Bulletins on various subjects such as Indian refractory clays, titanium oxide recovery, the manufacture of liquid gold and of china glass for use in the ceramic and glass industries, and the utilisation of Indian vegetable oils as lubricants or fuels in engines. Arrangements were made for the publication of bulletins on the leather, handloom, and silk industries and on other industrial subjects.

Other activities of the Bureau were connected with the development of improved glass-melting furnaces and pots, the production in India of the materials necessary for the preparation of bakelite type and shellac moulding powders, artificial silk manufacturing possibilities, and numerous industrial enquiries.

The staff and consequently the activities of the Bureau suffered considerable curtailment at the outbreak of war, but the Bureau, including the Research Branch, were subsequently merged into the recently formed organisation of the Director of Scientific and Industrial Research, by which this kind of work is being continued on a larger scale.

RADIO IN UPPER AIR INVESTIGATION

BY

S. V. CHANDRASHEKHAR AIYA

(School of Radio-Physics and Electronics, S. P. College, Poona)

1. Introduction

THE values of temperature and humidity and the velocity and direction of wind vary with altitude in the atmosphere and are also subject to seasonal and diurnal variations. For purposes of weather forecasting, data regarding these would be of enormous value if they can be collected at frequent intervals from a network of observatories. A knowledge of the height and thickness of cloud is also of importance to the meteorologist. A study of the variation in the intensity of ultra-violet solar radiation with altitude has proved to be of great help for elucidating the composition of certain layers of the atmosphere. Accurate information on the variation of cosmic ray intensity with altitude has been useful in elucidating the nature of the radiation. These several problems of the upper air have already been attacked and a considerable body of data collected.

There are at present three principal methods for studying conditions in the upper air:—

(*a*) A direct ascent is made in an aeroplane or a manned balloon and the required quantities are measured at different altitudes. This method, while useful, is costly. Besides, it is difficult to ascend to great heights without elaborate organisation.

(*b*) The second method is to send up an automatic recording instrument like the Dines' meteorograph in an unmanned balloon. After the balloon has burst, the instrument descends by parachute and, if it lands in a populated area, can be picked up and the records worked out. This method is comparatively inexpensive and easy, but has its disadvantages. In countries like ours, about fifty per cent. of the instruments sent up are never recovered. There are regions like Baluchistan, the Himalayas and the seas surrounding the country where the recovery would be so difficult as to be practically impossible. Some instruments are returned in a damaged condition. Often there is a considerable delay in getting back the instrument. These are serious drawbacks of the method.

(*c*) The third method is the radio method. A small radio transmitter is sent up with a balloon. The varying readings of the different instruments which accompany the transmitter are signalled in a suitable manner by the transmitter and can be received by a radio receiver at the ground station. This method has considerable advantages over the other two and need not be very expensive. In due course, it may become practically as inexpensive as the second method which is at present the cheapest. "Radio-Sonde" as this instrument is popularly called is constructed in different ways and is being used with varying success in several countries (see references I to IX). In some countries like the United States of America, this method already forms part of a regular service for collecting information for weather forecasting purposes.

In this paper, it is proposed to give a critical review of the main principles and practice of the method with special reference to starting the work in our country.

2. Transmitter Design

Upper air data at levels up to 20 kilometres are generally required. The balloon which carries the transmitter ascends at the rate of about 200 metres per minute. It, therefore, requires about a hundred minutes to reach the maximum height. During this time, the balloon is carried by the wind and travels a horizontal distance which generally lies within 200 kilometres. In most cases, the distance travelled is much less. The transmitter has, therefore, to be designed in such a way that it can radiate signals of sufficient intensity for satisfactory reception from a distance of 200 kilometres. At this distance, the transmitter radiates energy at an angle of 3° to 4° to the horizontal. Hence the radiation practically travels along the ground. Work has been done on the calculation of intensity at different distances in such cases.[28] The theoretical calculations do not agree exactly with experiment. For purposes of a rough estimate, it will be adequate if calculations are carried out on the basis of the simple theory of the Hertzian dipole, as the signal received is mostly a direct one, *i.e.*, *via.* the optical path. For a *half-wave aerial*, this theory gives the following value for the field X, at a distance d (in metres), from the transmitter:

$$X = \frac{94 \cdot 2}{d} \cdot I_s \text{ volts/metre}$$

where I_s is the antenna current in amperes.

This calculation neglects diffraction, reflection from the ground and refraction through the atmosphere. Diffraction can be neglected as we are concerned with transmission along the optical path. Reflection can be neglected as most parts of our country are not flat but hilly. Refraction would cause a fading of the signal.

The field, X, must have a value exceeding the noise level. Atmospherics and man-made statics like motor-car ignition, etc., are responsible for this noise. It is, however, generally well-established that noise level is below a fraction of a micro-volt per metre on wave-lengths below 15 metres. But man-made static may be so serious that it may raise the noise level between 5 and 10 metres to about one micro-volt per metre. Below 5 metres, this noise is quite negligible. Therefore, we may tentatively conclude that a signal of one micro-volt per metre can be received. Actually receivers can be so sensitively designed that a signal of even ¼ micro-volt per metre can be received. But

the lower limit of signal strength is also determined by the noise level and hence the above conclusion.

Substituting for X the value, one micro-volt per metre and taking $d = 200$ kms., we get

$$I_s = 2 \cdot 12 \text{ milliamperes.}$$

This gives the average current required in the antenna. Therefore, the maximum current will be $\pi/2$ times this, *viz.*, 3·33 milliamperes. The antenna, therefore, requires an R.M.S. current of 3·33 mA and, being a half wave antenna, has a radiation resistance of 80 ohms. Therefore, the power radiated will be 266·4 mW. Assuming 40% efficiency for the transmitter, the d.c. input works out to be 666 mW. Hence it is clear that a d.c. input of 10 mA at 67 V would be quite adequate. We have neglected the pure ohmic loss of power in the aerial. This can generally be kept down by proper aerial design. The battery Voltage falls due to drain and particularly due to the lowering of temperature at high altitudes. Taking all these factors into account, it is clear that 10 mA at 90 V as a d.c. supply to the transmitter is more than adequate. Actually satisfactory signals have been received with a 45 V plate supply![14]

Having dealt with the power requirements, the choice of wave-length may be considered. Wave-lengths varying from 150 m. to 1·6 m. have actually been used. The following facts must be considered in the choice of a proper wave-length:

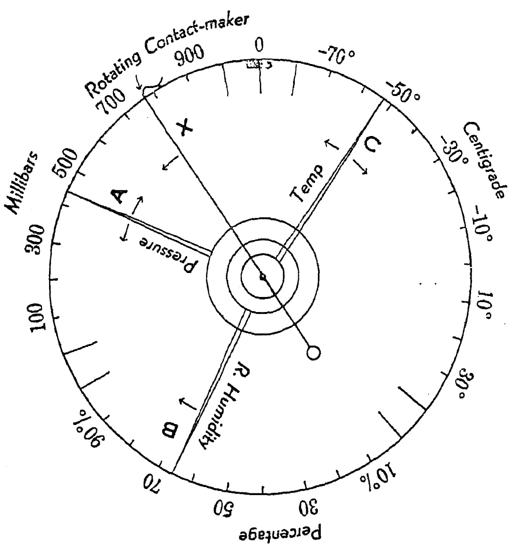


Diagram to illustrate the "Olland Principle" used in radio-meteorographs.

(1) Decrease of wave-length leads to a reduction of noise level.

(2) The lower the wave-length, the shorter the length of the aerial.

(3) Smaller wave-lengths are advantageous for direction-finding. On such wave-lengths, it is easier to design sharply directed arrays.

(4) For wave-lengths much above 10 metres, there is always a possibility of other communication systems causing interference. Very often the trouble may be due to a harmonic from a nearby broadcasting station.

(5) The transmitter designed for this work does not maintain its frequency absolutely constant. This may cause interference with other communication systems. Hence a band that is least crowded must be used.

(6) Below 5 metres, the ordinary valves cannot be used efficiently and special valves will have to be used. This would increase the cost of the equipment.

Taking all these facts into account, it is evident that a wave-length between 4 and 10 metres would be the best. This is the general tendency in recent years. The international radio-sonde band is 10·7 to 10·9 metres according to the new convention. But it is probable that permission to work on lower wave-lengths can be granted in countries where the ultra short wave band is not put to much use.

The transmitter, for such wave-lengths and power, consists of a one-valve oscillator. In some cases, two valves are used in push-pull (13, 18). A high degree of frequency stability cannot be expected with such a simple transmitter but it is found that the frequency variation is small and practically negligible. If, in future, work is restricted to the international band, some type of master control will have to be used. The general practice is to use ordinary receiving valves, midget types or general purpose valves. For wave-lengths below 4 metres, acorn tubes are used and they are costly. When an ordinary receiving valve is used, the base is generally removed to reduce weight. In America, mostly the type 30 valve is used for the oscillator. Such a valve should cost us Rs. 3 or less.

With such valves, conventional circuits are generally employed. On longer wave-lengths, a tuned plate circuit inductively coupled to the grid circuit is common. On shorter wave-lengths, Hartley, Colpitts and tuned-plate tuned-grid circuits are generally employed. As far as possible, the use of resistors is minimised to avoid loss of power. On wave-lengths like 5 m., no extra capacity is required for the tank circuits of the tuned-plate tuned-grid type. The self capacity of the coils and the valve inter-electrode capacities are found to be adequate. The former can be varied by pressing the coil which really consists of a few turns of wire, for tuning.

Even after standardisation, the wave-length of the wave radiated is bound to differ slightly from one transmitter to another due to small differences in valve constants, circuit *design*, etc., but this is small. When the temperature changes, it affects the electrical constants of the circuit and the battery voltage. Besides, the battery voltage may change with drain. As a result, there is a frequency drift of the oscillator. This has amounted in some cases to as much as 300 Kc./sec. on the 60 mc./sec. band. To allow for such possible changes, it is desirable to use a flatly tuned receiver. Accordingly a super-regenerative receiver is very frequently employed. If a superheterodyne receiver is employed, slight retuning may become necessary now and again.

The aerial used is generally a half-wave antenna. In most cases, it is voltage-fed and this is found to be most satisfactory. A current-fed antenna has also been used but the former is to be fed at the centre and, therefore, will extend on both sides of the radio-sonde.

3. Transmitter Power Supply

The power requirements of the transmitter vary with the type and number of valves used. Speaking generally, they are roughly as follows:

L.T.: 60 to 200 ma at about 3V.
H.T.: 5 to 15 ma at about 90V.

The power required is extremely small but, since the power supply unit has to be as light as possible, it creates special problems. In the majority of cases, the greater part of the weight of the radio-sonde is due to the power supply unit. If the supply unit has a capacity enough to last about three hours, it is quite adequate and still the problem is serious.

Small accumulators are used for both H.T. and L.T. supplies by some. It is difficult to construct such H.T. accumulators. Small plates have to be formed and acid-proof insulation provided between cells. In places where there is an arrangement for making rubber containers and paste plates for aeroplane accumulators, the problem is not serious. But, in our country, it is likely to present a serious problem. There are, besides, certain general disadvantages of accumulators. There is the danger of acid spilling and spoiling other parts of the radio-sonde. The accumulator cools on discharge and as it is to be sent up to regions where temperatures are as low as $-80°$ C., special arrangements will have to be made to provide heat to the accumulator. Hence, it is preferable to avoid the use of accumulators.

Dry batteries have been used by several workers. If they are insulated in a balsa wood box, they are found to give reliable service. In our country, deal wood boxes may be tried with advantage. If the transmitter is designed for continuous operation, the heat of the valve or valves and the battery is adequate to prevent freezing in the battery. For L.T. supply, ordinary flashlight batteries are found to combine lightness and the required capacity. For H.T. supply, special layer-built (like a voltaic pile) 45 V batteries are manufactured for the purpose. The 'Eveready' 45 V battery weighs about 2 oz. and has a capacity of a few milliampere hours. But such batteries cannot be imported because they have only a short life. It should be possible to make such batteries in our laboratories after some initial experiments. Perhaps, we may not get down to as low a weight but still, this appears to be the best approach to the problem.

Some workers use dry batteries for L.T. and a vibrator transformer to convert L.T. to H.T. pulses at audio frequency. By this method, it is difficult to secure reliable operation and difficulty has been experienced in starting and stopping the transmission. Hence this would be a serious difficulty if the transmitter is designed for intermittent operation.

4. Signalling

Instruments for indicating pressure, etc., are sent along with the transmitter and several methods have been devised to signal their readings. The fundamental principles underlying the methods will be discussed briefly.

(*a*) *Moltchanoff's signalling method.*—The plate circuit is completed only when the indicator of the meteorological instrument makes metallic contact at certain predetermined values of the parameter to be measured, and for each value a different type of signal is sent. Thus, for a pressure of 800 mb., a letter *i* may be sent for 700 mb., the letter *o* and so on. If two parameters are to be measured, each sends a different type of signal. The operator at the receiver has to receive these signals and later decipher them. The method was used in the early days by Moltchanoff and recently by the Dutch workers. It is complicated and sends signals only at certain predetermined values of pressure, temperature, etc. This is a disadvantage.

(*b*) *Carrier frequency variation.*—The best example of this is the Finnish radio-sonde. By a drive mechanism, four different condensers are brought in parallel across the coil in the plate circuit in turn. Two are fixed. The capacity of one is varied by the pressure indicator and varies with pressure and that of the other is varied by the temperature indicator. Hence, the transmitter radiates in quick succession, two fixed and two variable frequencies. The variable frequency change is a measure of pressure or temperature, as the case may be. The variable frequencies are measured as a difference with respect to the fixed frequencies. Therefore, if there is any frequency variation due to temperature change, etc., it will affect all the frequencies. Hence the accuracy of the readings will not be affected.

The only factor affecting the accuracy lies in the fact that the instrument has to be calibrated with the aerial in position. Generally, different readings are obtained with the transmitter inside and outside a building. It should, however, be possible by certain preliminary experiments to make an allowance for this. The method gives readings of different parameters in quick succession so that it will be practically equivalent to obtaining information on the several parameters simultaneously. This is an added advantage of the method.

Vaisala works on the 15 mc./sec. band and the frequency variation required for measurements of the required accuracy is about 1000 kc./sec. It is extremely doubtful whether permission can be obtained to work over such a wide band, and, that too, in an important communication band. If we were to use the ultra-high frequency band, the capacities would become too small and its adoption would present difficulties but it is worth making an attempt. On the band used at present by Vaisala, there is likely to be interference from broadcasting and other communication channels. This will not arise on the higher frequencies.

(*c*) *Olland principle.*—Many radio-sondes operate on this principle. It can be illustrated by taking an example. (Fig. 1.) Suppose pressure, temperature and humidity are to be

measured. A pointer, X, is rotated at constant speed by a clock, motor or other mechanism. Let O be a fixed point on the circle which its end describes. The pressure variations move another pointer A from an angle of, say, 10° on the circle to another position, say, 110°. Similarly a third pointer B attached to the humidity indicator moves from 120° to the 220° when the humidity changes from 0 to 100 per cent. and a fourth pointer C attached to the temperature indicator moves from, say, 230° to 350°. Suppose the transmitter plate circuit is completed whenever the pointer X touches O or the pointers A, B or C. The signals corresponding to contact with O will occur at regular intervals of time. The signal due to A corresponding to pressure, due to B corresponding to humidity and that due to C corresponding to temperature occur at time intervals after the O signal depending on the values of these parameters. The duration of the signals due to O, A, B and C may be made different so that they can be distinguished. This method, therefore, would measure pressure, etc., in terms of time intervals. By this method, we can obtain consecutive, but not simultaneous records of different parameters.

The most common drive employed is the clock drive and this limits the accuracy of measurements. With any escapement, there are a limited number of jumps of the clock hand per minute and the least count of the indicator will be determined by the range of the parameter equivalent to each jump. Escapement errors are most common. Cheap watches and clocks are affected by temperature. When the temperature is lowered as the balloon goes up, sometimes they move faster because of increased spring tension but at some other times, they move slower because of the thickening of oil. Experience has shown that the variation in speed is thus rather erratic. Most of them stop operating below −30° C. They must, therefore, be kept in an insulated enclosure. It is difficult to supply the clock with the exact amount of heat it is likely to have at different altitudes inside this enclosure at the time of calibration.

Recently,[21] a motor drive of constant speed has been tried and is reported to operate at very constant speed. But the problem of obtaining or making such motors is likely to present difficulties for us here. Other types of drive have been tried but the above two can be considered as representative.

(*d*) *Modulation.*—Audio frequencies can be generated by a valve oscillator and the frequency can be varied by varying the inductance of the tuned circuit. In Thomas's method,[1] the inductance is varied by an iron disc attached to the indicating instrument, which moves as the parameter to be measured changes, and varies the air gap in the inductance. Hence the frequency of the audo-oscillator is a measure of the parameter to be measured. This audio frequency modulates the R.F. of the oscillator. At the receiving end, the signal is demodulated and the frequency of the A.F. measured. The latter is a measure of the pressure, etc.

In the audio-oscillator used by Dunmore and others[22,23] the frequency is varied by varying the value of the grid leak. Pressure, etc., vary the value of the grid leak and hence the audio frequency. In other respects, the design and technique are similar to those of Thomas.

This method requires extra valves for generating A.F. oscillations and modulation and extra power for the purpose from the power supply unit. The radio-sonde of Thomas weighs 2,390 grm. This is a very high weight for a balloon transmitter. Diamond and co-workers' radio-sonde weighs 2 lbs. It is difficult to reduce the weight of this type of radio-sonde to as low a value as that of similar instruments based on other methods. But, it is quite likely that this method will give the highest degree of accuracy. An added advantage of the method lies in the fact that the transmitter continuously radiates. Hence continuous records of all parameters can be simultaneously obtained by suitable design and adjustment of audio-frequency variations to different bands for different quantities, *viz.*, say, 700 to 1000 c/s. for pressure, 1400 to 1700 3/s. for temperature and so on as was done by Thomas. Besides, the same radio-sonde can be used for direction finding purposes also.

5. Application to Meteorology

The most important application of this method is to meteorology. The meteorologist requires a knowledge of pressure, temperature, humidity and wind velocity and direction for weather forecasting. In clear weather, wind velocity and direction can be obtained by sighting the balloon with a theodolite. But this is not possible in cloudy weather when a knowledge of wind velocity and direction would be particularly valuable. If the balloon transmitter is *continuously radiating* at a fixed frequency, its direction can be determined by suitable direction-finding apparatus and hence the wind velocity and direction obtained.

The transmitter has to signal the values of pressure, temperature and humidity. Pressure decreases with height from about 1000 mb. at the ground level to 50 mb. at 20 kms. A knowledge of pressure to an accuracy of 2 mb. is desirable. Temperature varies from 40° C. to −80° C. and an accuracy of 1° C. is required in temperature measurements. Relative humidity has to be measured to an accuracy of 5 per cent. It is desirable that the values of all these three quantities are obtained simultaneously, *viz.*, pressure, temperature and humidity at the same altitude. This is possible when the modulation method is used. In other methods, we obtain pressure at one time, *i.e.*, at one altitude, temperature at a later moment, *i.e.*, at another altitude, and humidity at a third altitude. A graph will have to be plotted to obtain the values of the three quantities at the same altitudes by interpolation. To avoid any error that may be caused by this method, the signals for the three quantities must be obtained in quick succession.

The instruments used for measuring pressure, etc., must be light and accurate. For pressure measurements, the aneroid is invariably used

and is found to be satisfactory. For temperature measurements, many workers use a bimetallic spiral. It is contended that it is difficult to design the latter to combine sufficient rigidity, stability and small thermal capacity. A wire suspended in an invar frame is used to indicate temperature and is found to work excellently. Craig[24] has constructed an electrolytic resistor, the resistance of which varies rapidly with temperature. This is used for temperature measurements by Diamond and co-workers. The bimetallic spiral is the simplest and cheapest. The metal wire suspended in an invar frame is probably the most accurate. For humidity measurements, the hair hygrometer is used by many. It cannot respond to abrupt changes and its time-lag is great at low temperatures. Curtiss and co-workers[21] use gold-beaters' skin and its response is found to be good. Dunmore[25] has devised an electrical hygrometer the resistance of which is found to depend markedly on humidity. This is used by Diamond and co-workers.

A knowledge of cloud height and thickness is of importance to the meteorologist. Feige[27] has determined them as follows. A photo-electric cell operates a milliammeter which varies the capacity of a condenser and this changes the carrier frequency of the transmitter. As the balloon passes through the cloud upwards, the light intensity changes and this alters the carrier frequency. Hence cloud height and thickness can be determined. Diamond and co-workers[23] connect the photo-cell to the grid circuit of the audio oscillator. Its resistance changes with light intensity and this changes the modulation frequency of the carrier wave.

6. Other Applications

Ultra-violet solar intensities in the stratosphere have been determined by an application of the radio method by Stair and Coblentz.[26] Their apparatus consists of an audio-oscillator, the frequency of which is determined by grid resistance. This A.F. modulates a carrier. By a special pressure switching arrangement, fixed resistors appear in the grid circuit of the audio-oscillator at predetermined pressures. This gives an indication of altitudes. Between pressure switching, a motor drive brings different light filters in front of a photo-cell connected to the same grid circuit. The resistance variation of the latter which corresponds to light intensities varies the modulating frequency. The latter is, therefore, a measure of light intensity.

Cosmic ray intensities[29] can be determined at different altitudes. Electrical impulses from a counter may be made to operate a relay to key the transmitter. The frequency of keying is a measure of the intensity.

Electrical conductivity and potential gradient can also be determined. Electrical charge may be collected on a conducting plate and this may be made to vary the grid bias of an audio-oscillator. When this varies, the audo frequency generated will vary. If the latter modulates a carrier, the modulating frequency will be a measure of the electrical conductivity.

7. Acknowledgment

The author thanks the Director-General of Observatories for permission to use the library of the India Meteorological Department and to see some of the radio-sondes available in the Department. He also acknowledges with thanks the assistance he received from Dr. K. R. Ramanathan by way of advice, discussion and suggestion while this paper was being prepared.

8. Summary

A critical review of the construction and use of the Radio-Sonde with special reference to starting research work in India on the subject is given.

9. References

References have been classified according to countries and, wherever possible, the wavelength used and the total weight of the radiosonde are given in brackets.

I. England:

1. Thomas H. A., *Proc. Roy. Soc.* (A), 1938, **167,** 227. (Wavelength = 8·6 m.; wt. = 2390 gm.)

II. France:

2. R. Bureau, *C. R. Acad. Sci.*, 1929, **188,** 1565; *Onde Electrique*, 1935, **14,** 10. (Wavelength = 14 m.; wt. = 1500 gm.)

III. Germany:

3. Heck and Sudeck, *Gerl. Beiträge*, 1931, **31,** 291. (Wavelength = 52 m.; wt. = 1800 gm.)
4. Duckert, *Beitr. Zur. Phys. der. freien Atm.*, 1933, **20,** 303. (Wavelength = 42, 47 and 6 m.; wt. = 645 gm.)
5. Kölzer, Graw, *Z. für. Geophysik*, 1936, **12,** 306. (Wavelength = 80 m; wt. = 450 gm.)
6. Lang, *Int. Met. Org. Denkschrift uber Radio-sonde Konstructionen*, Berlin, 1937, p. 28. (Wavelength = 45 m.; wt. = 675 gm.)
7. Becker and Hey, *Ibid.*, 1939, p. 9. (Wavelength = 31 to 39 m.; wt. = 640 gm.)

IV. Russia:

8. Moltchanoff, *Met. i. Hydrologia*, 1936, **2,** 30. (Wavelength = 130 to 150 m.; wt. = 400 gm.)

V. Holland:

9. Van Soest and Insje, *J. Roy. Met. Soc.*, 1940, **66,** 317.

VI. Finland:

10. Väisäla, *Mitt. des. Met. Inst. der Universität, Helsingfors* 1932, **20,** 1, and 1935, **29,** 1; *Ibid. Helsinki*, 1937 **35,** 1; *Bull. Am. Met. Soc.*, 1936, **17,** 148. (Wavelength = 19·5, 20·5 m.; wt. = 395 gm.)

VII. Japan:

Int. Met. Org. Denkschrift, Berlin, 1937, p. 12. (Wavelength = 22 and 20 m.; wt. = 929·6 gm.)

VIII. Italy:

Ibid., 1939, p. 12. (wt. = 600 gm.)

IX. U. S. A.:

(a) Blue Hill observatory (Lange, Bent, Pear and others).—

11. *Bull. Am. Met. Soc.*, 1935, **16**, 233, 267, 297.
12. *Ibid.*, 1936, **17**, 136.
13. *Ibid.*, 1937, **18**, 99, 107.
14. *Ibid.*, 1938, **19**, 299.
15. *Trans. Am. Geophys Union*, 1935, **16**, 144; 1937, **18**, 141.
16. *Beitr. Phys. Atm.*, 1937, **24**, 243.
17. *J. Aero. Sci.*, 1938, **6**, 59. (Wavelength = 5 m.; latterly f = 68 mcs./sec.: wt. = 500 to 850 gm.)

(*b*) Curtiss and co-workers.—
18. *Bull. Am. Met. Soc.*, 1936, **17**, 294; 1937, **18**, 391; 1938, **19**, 29.
20. *J. Aero. Sci.*, 1935, **3**, 35.
21. *J. of Res. Bureau of Standards*, 1939, **22**, 97. (Wavelength = 5 m.; wt. = 523 gm.)

(*c*) Diamond and others.—
22. *Bull. Am. Met. Soc.*, 1937, **18**, 73; 1938, **19**, 129; 1938, **19**, 343.
23. *J. of Res. Bureau of Standards*, 1938, **20**, 368. (f = 65 mcs./sec.; wt. = 2 lbs.)

(*d*) California Institute of Technology and Guggenheim Aeronautics Laboratory.
Int. Met. Org. Denkschrift, Berlin, 1937, p. 64. (Wavelength = 1·6 m.)
24. Craig, *J. of Res. Bur. of Standards*, 1938 **21**, 225.
25. Dunmore, *Ibid.*, 1938, **20**, 723.
26. Stair and Coblentz, *Ibid.*, 193 , **20**, 185.
27. Feige, *Z. f. Instrumentenkunde*, 1934, **54**, 23.
28. (*a*) Handel and Pfister, *Proc. I. R. E.*, 1937, 25, 346; 1938, **26**, 240 (and papers referred to therein.)
(*b*) Eckersley, *J. I. E. E.*, 1937, **80**, 286.
(*c*) Van de Pol and Bremmer, *Phil. Mag.*, 1937, **24**, 141 and 826.
(*d*) Report on Radio Wave Propagation, *Proc. I. R. E.*, 1938, **26**, 1193.
29. (*a*) Curtiss and others, *Phys. Rev.* 1938, **53**, 23.
(*b*) Johnson, *Trans. Am. Geo. Union*, 1937, **18**, 150.
(*c*) Doan, *Rev. Sci. Inst.*, 1936, **7**, 400.
(*d*) Dymond and Carmichael, *Geograph. J.* 1938, **92**, 410.

THE MARKETING OF GRAPES IN INDIA

THE recent Report* published by the Agricultural Marketing Advisor to the Government of India brings together much useful information regarding the production and trade in these fruits in India and stresses the need and the scope for extending the cultivation in the country. While the consumption of fresh grapes in India is nearly six and a half lacs of maunds and that of dried grapes is two and a quarter maunds India produces only some three and three-quarter maunds of the fresh fruits and none at all of the dried grapes, so that she imports over a third of her requirements of fresh grapes and the whole of her dried grape requirements from abroad. The present area under grapes is put down as 4,200 acres and the scope for extension to supply her full requirements is estimated as an additional 12,500 acres. In spite of this great scope for extension the areas under the fruit has remained practically unchanged, indicating the desirability of both experimental work and propaganda. It is interesting to note that Baluchistan accounts for about 58 per cent. of the present area, with Bombay coming next with 23 per cent.; Mysore and Madras account for 1·2 and 6 per cent. respectively. A description is given of the large number of varieties grown in the country and the peculiarities of their methods of cultivation. There appear to be numerous problems connected with the various aspects of the cultivation which are all indicated briefly together with useful suggestions in the same regard. A very noteworthy fact is the very high yield of the fruit in this country. India in fact leads in this matter; Mysore and Bombay give the highest yield per acre in the world, *viz.*, 11,610 lbs. and 11,160 lbs. respectively, with California—the great grape country—coming second far behind with 7,678 lbs. per acre. The report draws attention to the profits from the cultivation which is put down as about Rs. 600 to Rs. 700 on the average with Rs. 2,000 as the top figure per acre. As a profitable crop ideally suitable for the small farmer and therefore as a valuable aid in the improvement of village life, the grape is commended for greater attention. As in the case of most agricultural products in India there is great need for improvements in marketing. The grade specifications introduced in Bombay and the N.W. Frontier Province are referred to and it is stated that such grading has been a distinct success as the higher returns due to grading amounted to as much as Re. 1–6–8 per maund. Among the many suggestions for improvement are those relating to transport facilities and the provision of cold storage accommodation in the distributing markets. That considerable experimental work is called for is evident from the references made to past failures such as the Indian Mildura Fruit Farm in the Punjab and the Dal Lake plantation in Srinagar, Kashmir, to which we may add the Mysore Fruit Syndicate and other pioneer ventures in Bangalore of about thirty years ago. The rapid extension referred to as having taken place in the Madura District, South India, demonstrates also that with a variety which is found suitable, propaganda has been eminently successful. We should refer readers to the report itself for a fund of useful information collected with painstaking accuracy.

A. K. Y.

* *Report on the Marketing of Grapes in India and Burma* (Manager of Publications, Delhi), 1940. Price Rs. 1-14-0 or 2*s*.

INDIA METEOROLOGICAL DEPARTMENT

In the Report on the Administration of the Meteorological Department of the Government of India* that has been recently issued, we have a brief survey of the various activities of the Department, and a concise account of the interesting developments that have taken place during the year. Considerable attention appears to have been directed as during previous years, to the subject of improving the weather forecasting facilities for airmen. The forecasting office at New Delhi was re-established and began to issue from 1939 October 1, forecasts and weather reports for aviators flying in the extensive area served by that centre. Some new observatories and current weather stations have been started to provide additional information along the principal air routes; and on the outbreak of war, arrangements were made for certain special services to meet the requirements of the Indian Air Force.

At the Meteorological Office, Poona, a new wireless station was opened in April 1939, for broadcasting synoptic weather messages. Thus there are in India, four centres collecting observations in their regions and broadcasting them as regional synoptic messages, *viz.*, Poona, Calcutta, Delhi and Karachi; the Poona Office, in addition, issues collective synoptics based on these regional synoptic messages, from which weather information for the whole of India can be obtained. The two systems are illustrated in Plates I and II of the Report.

Considerable progress has been made with the arrangements for the transfer of the Upper Air Observatory at Agra to New Delhi. Besides other advantages the transfer is expected to facilitate the establishment of a closer *liaison* of the Department with aviation interests.

Sounding balloon ascents have been made at seven stations; about 500 balloons carrying meteorographs were released, out of which 229 have been retrieved. In order to obtain more precise information about the structure, process of information and movement of tropical storms, it has been proposed to have a large number of sounding balloon ascents ("swarm ascents") made in the field of such storms during their progress over a particular area. The Department also rendered assistance to Dr. R. A. Millikan and his colleagues who visited India for securing data in connection with their researches on cosmic rays. The observations were made at Agra, Gwalior, Peshawar and Bangalore where large balloons carrying recording instruments were released for the purpose.

The section of agricultural meteorology has continued its useful work, chiefly in investigations connected with the effect of weather and climate on crops—a subject of supreme importance to a country like India which is mainly agricultural. The researches carried out by this section include, among others, the measurement of the effect of wind-breaks and shelter belts by means of a hot wire anemometer and an investigation to evaluate the effect of topography on local climate by comparative observations at four selected stations a few miles apart from each other. Of particular interest is the work on "precision observations" at Poona and Karjat designed to reveal the effect of weather on crops. By the application of the sampling methods developed by Prof. R. A. Fisher, important results have been obtained which are useful in studying the behaviour of the rice crop during six different seasons. Considerable attention has also been given to certain statistical investigations in connection with agricultural problems. It is gratifying to note that the Government has decided to finance this section from the Central Revenues for a further period of three years.

An important feature in the development of the Colaba Observatory is the appointment of a special officer for seismological research. Various problems relating to earthquakes in India and its neighbourhood have been receiving attention and investigations have been made of the characteristics of certain important shocks such as the Satpura Range earthquake of March 14, 1938 and the great Pacific earthquake of November 10, 1938.

At the Kodaikanal Observatory, studies of solar phenomena have been continued and observations have been made as usual with the spectroheliograph, the spectrohelicscope and other instruments. Among the special researches may be mentioned the detailed study of the bright solar eruption of March 3, 1939 and of the unusual solar activitiy during August and September 1939.

Appendix B of the Report contains a list of departmental publications issued during the year as well as of the occasional papers contributed by the members of the staff, which is a good indication of the amount of valuable and interesting work carried on by the Department in the various directions of its activities.

T. P. B.

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* *Report on the Administration of the Meteorological Department of the Government of India in* 1939–40. (Manager of Publications, Delhi), 1940. Pp. 35. Price Rs. 1–2–0.

CENTENARIES

Lexell, Anders Johann (1740 1784)

ANDERS JOHANN LEXELL, a Finnish astronomer, was born at Abo in the south-western coast of Finland, December 24, 1740. He became professer of mathematics in the University of Abo in 1768 and went over to a similar post in St. Petersburg in 1771.

Lexell was a prolific writer. His first contribution entitled *Researches sur la vrale orbite de la comte de l' an* 1769, *etc*., appeared in 1770. The last which appeared posthumously in 1787 was entitled *Disq. de theoremete quodem singulari Lamberti, etc.*

Perhaps Lexell's name is best known in connection with the discovery of Uranus, which was the first planet to be discovered in historic times. On March 13, 1781 Sir William Herschel noticed a new heavenly body larger than fixed stars and suspected that it might be a comet. For a long time people could not compute a satisfactory orbit for the supposed comet, because it seemed to be near the perihelion and no comet had ever been observed with a perihelion distance from the Sun greater than four times the earth's distance. Lexell was the first to suspect that this was a new planet eighte[illegible] times as far from the sun as the earth is. [illegible] 1783 Laplace published its eliptic eleme[illegible] and Lexell's suspicion was confirmed. The pap[illegible] of Lexell on the subject appeared in 1[illegible] under the title *Recherches sur la nouv. plane[illegible] discouverte per Herschel.*

Lexell's name is also associated with [illegible] discovery of the deflection of comets. In 1[illegible] he discovered a comet which had been deflect[illegible] in 1767 by Jupiter out of an orbit in which [illegible] was invisible from the earth into an orbit [illegible] a period of 5½ years, enabling it to be se[illegible]. In 1779 it again approached Jupiter closer t[illegible] some of his satellites and was sent off [illegible] another orbit, never to be again recogni[illegible]. Lexell's paper on the subject appeared in 1[illegible] under the title *Reflexions sur le temps peri[illegible] que des cometes en general et principalem[illegible] sur celui observee en 1770.*

Lexell died at St. Petersburg, November [illegible] 1784.

S. R. RANGANATHA[illegible]

University Library,
Madras.

SCIENCE NOTES AND NEWS

Radio-frequency Spectra. In the *Physical Review*, 1940, 57, 765, P. Kusch, S. Millman and I. I. Rabi describe a new method for studying the radio-frequency spectra of atoms. When the energy of an atom changes on account of a change in the orientation of the nuclear spin, the frequency of the quantum corresponding to this change of energy is of the order of a few thousand megacycles, and the idea underlying the experiments is to produce oscillatory currents of such a frequency and employ them so that a reorientation of the nuclear spin is brought about. The occurrence of such a reorientation is examined by the method of molecular beams. A beam of atoms is projected through two inhomogeneous magnetic fields so arranged that the deflection of the beam produced by the first is exactly compensated by the second when the orientation of the atomic magnets is not changed during their passage from one field to the other. Next, a suitable homogeneous magnetic field is produced in the space between the two inhomogeneous fields. A weak oscillating field is set up perpendicular to the homogeneous field and the frequency is adjusted so that the nuclear spin of the atom changes from one to another of its possible positions in the given homogeneous magnetic field. Thus the frequency inducing such a transition is equal to that of the quantum corresponding to the change from one hyperfine Zeeman level to another. When such a reorientation occurs, the deflection due to the first inhomogeneous field will not be compensated by the second inhomogeneous field and hence the intensity of [illegible] atomic beam at the collector falls. By obs[illegible]ing the various frequencies of the oscillat[illegible] field at which such minima of intensity [illegible] the various hyperfine Zeeman components [illegible]responding to the homogeneous magnetic [illegible] can be determined. This is called the [illegible] frequency spectrum of the atom. Since [illegible] authors were able to measure the frequency [illegible] the oscillating field to an accuracy of one [illegible] twenty thousand, the accuracy in the measure[illegible]ment of hyperfine structure components [illegible] been improved a hundred fold, so that we [illegible] expect many questions of nuclear structure [illegible] receive new light from these measurements. [illegible] an example of the results, we may quote [illegible] following from the paper of Millman [illegible] Kusch, *Phys. Rev.*, 1940, 58, 438

Nucleus	Δν of ground state [illegible]
Na^{23}	0·05916
Rb^{85}	0·10127
Rb^{87}	0·22797
Cs^{133}	0·30661

T. S. [illegible]

Is produce grown with chemical manures deleterious to health?—A rather startling answer, in the affirmative, to this very important question is furnished by Dr. G. B. Chapman of the Physical and Mental Welfare Society of New Zealand and an account of a three-year experiment in the feeding of school-boys on fruit and vegetables grown on soil manured exclusively with 'humus' as against chemical fertilisers, conducted in one of the school hostels in that country is reported in support of the conclusion (*Nature*, June 8, 1940). It is stated that prior to the experiment the subjects, comprising some sixty boys, teachers and staff, were being fed on a liberal dietary well above the customary standard for boarding schools but that they were nevertheless consistently suffering from colds, catarrh, septic tonsils, epidemics of influenza, dental caries and other preventible complaints. The food supply was being derived from the ordinary New Zealand produce which, the report says, was all being grown on soils manured only with chemical fertilisers. It is rather hard to believe that New Zealand soils receive no kind of organic matter at all which would furnish humus; what then becomes of the farm-yard manure, the excreta of the sheep and poultry, the crop residues on the land, and all the plant material not used as or useful for food is not made clear. On the assumption however that the local produce is all from soils only manured with artificials, it was decided to grow on the school land, fruits and vegetables manured only with 'humus' for consumption in the hostel and these, it is said, now supply the greater proportion of the requirements of some 77 persons. In the twelve months following the change-over a marked improvement in health resulted. Catarrh, which was general previously, declined as likewise did cold and influenza. In an epidemic of measles in 1938 which was general in New Zealand new boys suffered from acute attacks while boys who had been in the school for a year or more (and fed evidently on the humus-grown food) suffered only mild attacks with a much more rapid convalescence. Fewer accidents occur in the football season indicating stronger bone formation; dental condition has improved, constipation and bilious attacks are rare and the boys are 'increasingly active and virile'.

Though a good deal is now being heard on the effect of farm-yard manure, as opposed to chemical fertilisers, in improving the "quality" of produce, in making the seed more productive, with a higher content of factors indispensable for growth promotion, one is hardly prepared for a sharp and vital distinction of the kind described in the above experiment. If the results can be confirmed by other workers and in a much larger number of experiments, under conditions capable of accurate control, it goes without saying, that they will have far-reaching practical importance besides bringing about a radical change in the present ideas of manuring and plant improvement. A. K. Y.

Entomological Results from the Swedish Expedition (1934) to Burma and British India.—The results obtained by the expedition have been reported in three papers published in *Arkiv. fur. Zoology* (32, Nos. 2–3). The expedition made extensive collections of certain common as well as little known insects in British India and Burma.

The greater portion of the collections consists of aquatic coleopterous insects belonging to the families Gyrinidæ and Dryopidæ.

The Gyrinid beetles are small shiny insects commonly found briskly moving about on the surface of water in ponds and streams, paddling themselves by means of their modified posterior legs, and excreting a fœtid liquid round about them.

Of the three important genera of Gyrinidæ, namely, Gyrinus, Dineutas and Orectocheilus, the last-named genus has been well represented in the collections besides yielding ten new species of considerable interest. The work of the Swedish expedition has thus widened our knowledge about one of the most interesting families of aquatic beetles.

The Dryopid beetles are little-known small, pubescent and aquatic beetles. The expedition has thrown much light on this family. The two principal sub-families, Dryopinæ and Helminæ have been studied in detail and one new genus and two new species in the former, as well as another new genus and three new species in the latter have been erected. The new subgenus Indosolus and the four new species of Grouvellinus are of considerable interest to the students of the family Dryopidæ.

Technical Institute, Delhi.—The Government of India have decided to convert the existing Government High School and Commercial Institute at Delhi into a *Technical Institute*, in pursuance of one of the main recommendations of the Abbott-Wood Report.

The proposed Institute will contain, in addition to an experimental Technical High School, provision for courses or classes in technical, commercial and art subjects for students already in or preparing to enter employment.

The Technical High School will provide for an annual intake of 60 pupils. The minimum age at entry will be eleven and the normal length of the course six years. The school will thus contain about 360 pupils and no reduction in the total facilities for higher education in Delhi will be involved. It is hoped to start the new venture in the school year 1941–42.

For the first three years the Technical High School's curriculum will be of a general character and similar to that followed in a good middle school so that at the end of this stage it may be possible to make transfers from and to schools providing the ordinary High School course.

After this stage the curriculum will include a certain number of subjects of a practical character, *e.g.*, the properties of materials, the elements of engineering science, measured drawing and simple design.

This second stage will last three years, the practical subjects occupying a progressively larger place during the last two years. Importance will be attached from the beginning to a sound practical knowledge of English and it will be possible for the pupils in their last year to take a suitable school leaving examination without any risk of their course of study being unduly circumscribed by examination requirements.

Mr. William Walter Wood, F.R.I., B.A., M.I.Struc.E., at present Principal of the Mid-Essex Technical College of Arts, Chelmsford, has been appointed Principal of the Institute. He is expected to take up his duties early in the new year.

Production of Drugs in India. Owing to the extended production of drugs in India as many as 92 drugs have been taken off the import list. The manufacture of disinfectants has been taken up by the Medical Stores Supplies Committee under the chairmanship of Lieut.-Gen. G. G. Jolly, I.M.S., Director-General, Indian Medical Service. The manufacture in India of Acriflavine is under investigation. Samples have already been produced in an Indian laboratory.

Tablets of vitamin C are now being produced from the Indian gooseberry, *amla*, which is available in large quantities in the Nilgiris. Amla berries are collected under the supervision of the Director, Nutrition Laboratories, Coonoor, dried and made into tablets of suitable size. The Committee is now contemplating the production of a more concentrated form of vitamin C.

Manufacture of China Glass. The manufacture of China glass, a decorating material used chiefly by the glass bangle industry, is described in detail in a recent bulletin of the Indian Industrial Research Bureau (*Bull. No. 17*: Manager of Publications, Delhi, 1940. Price As. 5 or 6*d.*). The process was perfected about two years ago by the Research Branch of the Industrial Research Bureau at the Government Test House, Alipore, and it was subsequently demonstrated that large-scale manufacture should present no difficulties. The details of the process were supplied to various glass manufacturers, through the Directors of Industries of certain Provinces and States, and it has been reported that China glass is now being produced in India and is being marketed by certain glass manufacturers at a price somewhat lower than that of the imported material. The publication of this bulletin, it is hoped, will further encourage the production of China glass in the country.

China glass is a dense opaque white glass of low melting point. Low melting characteristics are essential, as otherwise the glass articles on which it is applied may be deformed during the process of application.

For decorative application, the solid glass is powdered fine—say to the consistency of ordinary flour—and a paste is made of it with water, and this paste is used to make the requisite artistic designs on the glass surfaces to be decorated. The decorated article is then fired in a furnace, which melts the decoratives and fixes them to the surface.

The material, when prepared as described on a factory scale, proved highly satisfactory and was comparable with the best quality of imported China glass.

A New Jute Substitute. Among the new fibres and threads produced mainly as substitutes for jute, ramie, hemp and similar natural fibres, the "Hofa" thread has drawn some attention of the trade. This thread consists of wood fibre stock and viscose, the latter serving as a binder. In contrast to the practice in wood pulp production, the wood fibre stock is entirely freed from "fibre slime" and fine fibre fragments by thorough washing, so that a less homogeneous fibre structure similar to that of raw cotton results. By suitable spinning and other treatment, a thread resembling hard fibres is produced.

Atmospheric Pollution. Despite the increasing industrial activity in the years preceding the outbreak of the war, the state of the atmosphere in the British Isles has shown a steady improvement since 1936. This is shown in the Report on the investigation of Atmospheric Pollution for the year 1938-39.

The local authorities making the measurements of atmospheric pollution on which the reports are based have decided to carry on with the investigation, if possible, since a knowledge of the state of the atmosphere is of importance even in war time. Although more urgent tasks have delayed its issue, the report on the year's observations has now been issued by the Department of Scientific and Industrial Research (The Investigation of Atmospheric Pollution, Twenty-fifth Report on Observations in the year ended 31st March 1939. Published by H.M. Stationery Office. Price 2*s.* 6*d.* net). The seasonal variation of pollution in cutting off daylight from the centres of towns is brought out in diagrams. The report also contains an article on the effect which atmospheric impurities have upon building stones.

A brief account of the valuable work carried out at the **Malaria Institute of India** during the year 1939, is given in the Annual Report of the Institute, issued recently. The Institute is financed by the Indian Research Fund Association.

The Field Station of the Institute which was located in Karnal (Punjab), was transferred to Delhi during the year. The step was taken after mature consideration. Delhi with its riverain problem, irrigation problem, rural and urban malaria problems offers an extensive field both for research and teaching.

During the year, the officers of the Institute published 11 research papers. Four numbers of the *Journal of the Malaria Institute*, containing 35 papers, were issued during the year. Other publications of the Institute include Health Bulletins, Miscellaneous reports and Notes.

The Institute maintains a museum well equipped in all respects for demonstration purposes in all branches of malariology, both for the members of the medical profession and laymen.

The intensive antimalarial operations in progress in the Delhi urban area were continued. The work consists in the application of larvicides, clean weeding of ponds, and in levelling and draining operations. Special attention has been given to the development of oil booms to deal with inadequate breeding in irrigation channels and stormwater drains and for the prevention of larval drift. The spleen census of school children and fever figures from Delhi dispensaries, showed a fall over the previous year's figures. The cost of the annual recurring antimalaria measures for the Del

urban area is Rs. 64,000 or just over two annas per head per annum of the population protected.

Rural Antimalaria Schemes have been started in various provinces as a result of the grant made by the Government of India to the *Indian Research Fund Association* for the purpose. Such schemes in operation are: 1 in Delhi Province, 3 in United Provinces, 3 in Madras and 1 in Bengal.

Much valuable research has been carried out both in the field and in the laboratory. One of the interesting results recorded relates to the existence of 2 entirely different biological races or species of *A. fluviatilis* as evidenced by the examination of the blood meals of the mosquitoes: the percentage containing human blood in the U.P. Terai is 1·4, as compared with 96·9 in Wynaad series. This finding is in agreement with the results of dissections.

Bose Research Institute.—"Scientific Research and the Future of Indian Industry" formed the subject of the Memorial Address, delivered by Dr. S. S. Bhatnagar at the Twenty-third Anniversary meeting of the *Bose Research Institute* held on the 30th November. The illustrious founder of the Institute was intimately associated with a number of experimental investigations having important industrial applications. To mention only a few, his investigations on the transmission of electric signals through space, and on the rectifying action and photo-conductivity of semi-conductors have received due recognition in the field of industry. A reference to this aspect of Sir J. C. Bose's work is to be found in the Director's annual report presented at the meeting.

The report also gives a resume of the work carried out by the research staff in the various departments of the Institute. Results of far-reaching importance have been obtained, and the Director must be congratulated for the successful manner in which he has conducted the work of the Institution.

Calcutta University.—The Syndicate has recommended to the Senate, that the Degree of Doctor of Science be conferred *Honoris Causa*, on Sir Nilratan Sircar, Kt., M.A., M.D., LL.D.

The Sir Asutosh Mookerjee Medal in Science, for the year 1939, will be awarded to Dr. B. Mukhopadhyay, M.B., M.D., D.Sc., in consideration of his thesis entitled, "Search for some Ephedrine-like Antispasmodic Remedies" and to Dr. Dinescandra Sen, D.Sc., for his thesis entitled, "Studies in the Camphor Series", the value of the medal being equally divided between the two candidates.

Andhra University: Natural Sciences College.—The Senate, at its meeting held on the 5th December, sanctioned the proposal of the Syndicate that a "Science College in the Faculty of Science be instituted; that Honours B.Sc. Degrees be instituted in Botany, Zoology and Geology; that Honours and Pass B.Sc. courses be instituted in Botany, Zoology and Geology in the above college and that the required cadres of the teaching staff in each of the three branches of learning be instituted". The Senate placed on record, its sense of deep gratitude to the Government of Madras for their generous grant to the Natural Sciences College.

This decision of the University is an important landmark in its history. The Government have sanctioned a capital grant of 3½ lakhs of rupees and a recurring grant of Rs. 40,000 for establishing the college.

SEISMOLOGICAL NOTES

During the month of November 1940 one great, one moderate and six slight earthquake shocks were recorded by the Colaba seismographs as against one great and six slight ones recorded during the same month in 1939. Details for November 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I. S. T. H.	M.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
1940		H.	M.	(Miles)		(Miles)	
November 4	Slight	14	00	1200	Hindukush Mountains	125 (approx.)	Felt in Peshawar
6	Slight	21	41	2090			
7	Slight	19	28	4140		260 (approx.)	
10	Great	7	9	3140	44°·5 N., 27°·0 E., in Rumania (Tentative)		Destructive in Rumania
13	Slight	17	6	1730			
19	Moderate	20	32	4280	In or near Japan		
20	Slight	23	30	1270	Near 36° N., 71° E., in the Hindukush mountains	115 (approx.)	Felt severely in Peshawar
27	Slight	20	12	5430			

MAGNETIC NOTES

The month of November 1940 was magnetically much more disturbed than the preceding month. There were 7 *quiet* days, 15 days of *slight* disturbance and 8 of *moderate* disturbance as against 10 quiet days, 19 days of slight disturbance and 1 of moderate disturbance during the corresponding month of 1939.

The day of greatest disturbance during November 1940 was the 25th and that of least disturbance the 10th. The classification of individual days is shown below.

Quiet days	Disturbed days	
	Slight	Moderate
2, 6, 8, 10, 11, 18, 28.	1, 3, 5, 7, 13 17 19, 20, 24, 26, 27, 30.	4, 9, 12, 21 23, 25, 29

There were three magnetic storms of moderate intensity during the month as compared with one of the same intensity during November 1939. The monthly mean character for November 1940 is 1·03 as against 0·70 for November of last year.

M. R. RANGASWAMI.

ASTRONOMICAL NOTES

The Earth will be at perihelion on January 3, 1941.

Planets during January 1941. Mercury after superior conjunction with the Sun on January 11, passes into the evening sky, and about the end of the month can be seen low down near the western horizon immediately after sunset. Venus continues to be a morning star and is gradually getting closer to the Sun; it will be visible for about an hour and a half before sunrise. Near the planet, and to the west of it, is Mars which is still faint and not favourably situated for observation.

Jupiter and Saturn continue to be apparently close to each other; the former which is in quadrature with the Sun on January 27, is a conspicuously bright object near the meridian at sunset. On January 10 Saturn will be at one of the stationary points of its geocentric orbit, and will afterwards resume its eastward motion among the stars. It will be in quadrature with the Sun on January 28. The Moon will closely approach the planet to a distance of about half a degree on the evening of January 7.

Algol.—Minima of Algol that can be conveniently observed in India, will occur on January 6, $0^h.5$, January 8, $21^h.4$, January 28, $23^h.1$ and January 31, $19^h.9$. The change in brightness is easily noticeable about an hour and a half before and after the times given.

T. P. B.

ANNOUNCEMENTS

The Indian Statistical Conference Benares, 1941.—The fourth session of the Indian Statistical Conference will be opened by His Excellency the Governor of the United Provinces at Benares on Thursday, the 2nd January 1941, at 2-30 p.m.

As in previous years the Statistical Conference will proceed with its work in close co-operation with the Indian Science Congress and four joint meetings have been arranged with four sections of the Congress. The Provisional Programme is given below:—

2nd January. 2-30 p.m. Opening Ceremony.

3rd January. 11 a.m. Joint meeting with the Anthropology Section of the Indian Science Congress: Discussion on "Correlational Analysis of Anthropometric Material". 2-30 p.m. Session for Applied Statistics.

4th January. 11 a.m. Joint meeting with the Mathematics Section of the Indian Science Congress. 2 p.m. Joint meeting with the Medical Section of the Indian Science Congress: Discussion on "Growth Studies with special reference to Nutrition and Public Health".

5th January. Whole day Excursion.

6th and 7th January. Reading of Papers.

8th January. 2 p.m. Joint meeting with the Agriculture Section of the Indian Science Congress: Discussion on "Standard Yields of Crops".

The Government of India, the different Provincial Governments, many of the important Indian States and Universities in India have given official recognition to the Conference and are expected in many cases to send delegates.

Members of the Indian Science Congress are cordially invited to attend the Opening Ceremony and all Sectional meetings and Joint discussions. Cards for the Opening Ceremony will be distributed from the Science Congress Office.

Indian Ecological Society. The first meeting of the above Society will be held on Tuesday, 7th January 1941, at 1-30 p.m., at Benares to transact the following business. Exact place of the meeting will be notified at Benares. (1) Election of Office-bearers for the ... (2) Discussion of the Constitution of the Society. (3) Discussion about the future programme of the Society. (4) Any other business they may be permitted by the Chairman of the meeting.

Proceedings of the Royal Society of Edinburgh. Owing to the national necessity for exercising the strictest economy in paper, and in order to reduce the expense of printing and publication, the Royal Society of Edinburgh has decided that, as from Vol. LXI, 1940-41, the *Proceedings* shall be published in two sections, *viz.*, "A" (the Mathematical and Physical, including Astronomy, Chemistry, Mathematics, Metallurgy, Meteorology, and Physics) and "B" (the Biological including Anatomy, Anthropology, Botany, Geology, Pathology, Physiology and Zoology). Fellows of the Society and Institutions with which the Society exchanges publications will benefit under the arrangement by having, in smaller compass, papers dealing with the subjects in which they specialise.

No change is proposed in the present ... or in the arrangement for the distribution of the Society's *Transactions*.

The Obituary Notices of Fellows, Proceedings of Meetings, List of Fellows, Prizes, etc., formerly published as APPENDICES at the ...

of each session's volume of *Proceedings* will, under the new scheme, be published separately, and will be sent normally to all Fellows and to those exchanges specially desiring to receive them.

Chronica Botanica.—The International Plant Science News magazine, established in Holland in 1935, is being published fortnightly in the U.S.A. from October 7, 1940 onwards (annual subscription, \$7·50, foreign and domestic, post free). It will continue to publish articles, discussions, digests, communications on the scientific, methodological and practical aspects of all branches of pure and applied plant science, news from institutions and societies, personalia, book reviews, queries, etc.

The "New Series of Plant Science Books" is being continued in the U.S.A., three volumes will be ready soon. Our first American List will be issued early this winter together with the annual questionnaire of Chronica Botanica. We will continue our Addressbooks and World List when international circumstances permit.

All correspondence, botanical specimens, journals, etc. for Dr. and Mrs. Verdoorn should now be sent to Chronica Botanica, P.O. Box 151, Waltham, Massachusetts, U.S.A.

Manufacture of Aluminium in India.—The Government of India, by a resolution, announce that "in view of the fact that the production of aluminium in this country is an urgent war necessity, the Government of India are pleased to give an assurance to all who wish to undertake the manufacture in India that, provided their affairs are conducted on sound business lines they will be given such measure of protection against unfair competition from outside India after the war as may be necessary to enable them to continue their existence."

Our attention has been drawn to an error in respect of the cost of the book "Science in War", review of which has appeared in *Current Science*, Vol. 9, No. 11, p. 508, the price of the book is 6*d*. and not 6*sh*.

* * *

We acknowledge with thanks the receipt of the following:—

"Allahabad Farmer," Vol. 14, No. 5.

"Journal of Agricultural Research," Vol. 60, Nos. 8–12.

"Agricultural Gazette of New South Wales," Vol. 51, Part. 9.

"Indian Journal of Agricultural Science," Vol. 10, Part 5.

"The Nagpur Agricultural College Magazine," Vol. 15, No. 1.

"Journal of the Annamalai University," Vol. 10, No. 1.

"Journal of the Indian Botanical Society," Vol. 19, Nos. 1–3.

"Contributions from The Boyce Thompson Institute," Vol. 11, No. 4.

"The Journal of Chemical Physics," Vol. 8, Nos. 8–9.

"Journal of the Indian Chemical Society," Vol. 17, No. 8.

"Experiment Station Record," Vol. 83, Nos. 1–3.

"Indian Forester," Vol. 66, Nos. 11–12.

"Indian Farming," Vol. 1, Nos. 9–11.

"Bulletin of the Indian Central Jute Committee," Vol. 3, Nos. 7–8.

"Review of Applied Mycology," Vol. 19, Parts 8–9.

"Indian Medical Gazette," Vol. 75, Nos. 10–11.

"The Merck Reports," Vol. 49, No. 4.

"Journal of Nutrition," Vol. 20, Nos. 2 and 4.

"American Museum of Natural History," Vol. 46, No. 2.

"Nature," Vol. 146, Nos. 3694–97 and 3703.

"Journal of Research" (National Bureau of Standards), Vol. 25, Nos. 1 and 3.

"Canadian Journal of Research," Vol. 18, No. 8.

"Sky," Vol. 4, No. 11.

"Lingnan Science Journal," Vol. 19, No. 4.

"Science and Culture," Vol. 6, Nos. 5–6.

"Ceylon Journal of Science," Vol. 3, Part 1 (Anthropology).

"Indian Trade Journal," Vol. 138, Nos. 1790–98.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 10, Part 3.

"Journal of the Royal Society of Arts," Vol. 88, Nos. 4568–69.

"Report of the Executive Committee of the Council of the University of Rangoon."

"Chemical Analysis of Kolhapur Waters," by J. W. Airan and S. V. Shah.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences: (*Proceedings*)

November 1940. SECTION A. C. V. RAMAN AND N. S. NAGENDRA NATH: *The two types of x-ray reflection in crystals.* The x-ray reflections of the Laue type are elastic collisions of the photons with the crystal considered as a structure with static space periodicities. The modified or quantum reflections are inelastic collisions in which the photon excites the vibration of the crystal lattice and is itself reflected by the dynamic stratifications of electron density arising from such vibrations. V. T. CHIPLONKAR: *The localisation of the discharge in ordinary and canal-ray tubes.* K. VENKATESWARLU: *Raman spectrum of sulphur.* The complete Raman spectrum of nine lines for a single crystal of rhombic sulphur has been recorded. The effect of crystal orientation on the Raman spectrum has also been studied. S. MINAKSHISUNDARAM: *On the expansion of an arbitrary function in a series of eigenfunctions of boundary value problems.* V. SUBBA RAO AND T. R. SESHADRI: *Chemical investigation of Indian lichens. Part I. Chemical components of* Roccella montagnei. P. BHASKARA RAMA MURTI AND H. KRISHNASWAMY: *Wax from* Butea frondosa *flowers.* P. BHASKARA RAMA MURTI AND T. R. SESHADRI: *Occurrence of free butein and butin in the flowers of* Butea frondosa. DARBARA SINGH: *Scattering of polarised light in colloids.* B. R. SETH: *Transverse vibrations of triangular membranes.* R. K. ASUNDI: *New bands in the triplet carbon system.* A few new band heads belonging to the triplet carbon band system of CO are reported.

November 1940. SECTION B. MISS K. P. NALINI: *Structure and function of the nidamental gland of* Chiloscyllium griseum *(Mill. and Henle).* N. L. SHARMA: *Rogite, a new variety of quartz from the Jharia Coal-field.* T. S. RAGHAVAN AND K. R. VENKATASUBBAN: *Studies in the Capparidaceæ, VIII. The cytology of* Capparis Zeylanica *Linn., and related genera.*

Indian Association for the Cultivation of Science: (*Proceedings*)

August 1940.—P. L. BHATNAGAR: *On the origin of solar system.* S. R. KHASTGIR AND ANIL KUMAR RAY: *On the intensity variations of the down-coming wireless waves from the ionosphere.* S. P. CHAKRAVARTY: *On wide band-pass effect in crystals associated with negative impedance elements and development of wide-band low-loss crystal band-pass filters.* A. K. DAS AND B. C. NARAYAN: *An apparent influ... of the earth on solar prominences.* S. BANERJEE AND PARAMANAND: *Variation of ... strength in the vicinity of an ultra-short-... horizontal transmitting aerial.*

Indian Botanical Society: (*Journal*)

November 1940. D. CHATTERJEE: *Two ... anonaceæ from Assam and Burma.* C. ... KRISHNA IYENGAR: *Development of embryo... and endosperm-haustoria in some member... scrophularineæ. V.* Ilysanthes hyssopi... *Benth.,* Bonnaya tenuifolia *Spreng.* ... RANJAN: *Studies on the photochemical actio... plants. I. The respiration of entire ... plants in light.* M. ANANTASWAMY RAU: *Stu... in the Apocynaceæ.* T. TATACHAR: *The deve... ment of the embryo-sac and formation ... haustoria in* Lantana indica *Roxb., and* St... tarpheta indica *Vahl.* K. V. RAGHAVA R...: *Gametogenesis and embryogeny in five ... of the convolvulaceæ.* M. J. THIRUMALACH...: *A method for germinating and staining tel... spores.* D. CHATTERJEE AND S. K. MUKERJ...: *Some new plants from India and Burma.* S... RANJAN: *Studies on the photochemical actio... plants. II. Photosynthesis in leaves at dif... temperatures.* SHRI RANJAN AND BRIJ B... LAL SAKSENA: *Studies on the photochem... action in plants. III. The influence of ... light on the rate of respiration of some colo... flowers.* SHRI RANJAN: *Studies on the ph... chemical action in plants. IV. The effec... violet and ultra-violet radiations on plant ... piration.* S. DORAISWAMI: *On the morph... and cytology of* Eudorina indica *Iye...* K. BISWAS: *Systematic position of a little ... flowering plant from South Burma.* ... *Effect of anthocyanin pigments on the ... photosynthesis in* Eranthemum *Spp.* M. ... IYENGAR AND S. KANTHAMMA: *On* Hormo... *a new member of the ulotrichaceæ.* M. ... IYENGAR AND S. KANTHAMMA: *A note on* Ulo... chopsis viridis *gen. et sp. nov.* S. KANTH...: *On the life-history of* Characium terre... *nov.* M. O. P. IYENGAR AND K. R. RAMANATH...: *On the reproduction of* Anadyomene ste... *(Wulf.) Ag.*

Meteorological Office Colloquium, Poona

November 19, 1940. B. N. DESAI, A. E. ... AND N. K. SUR: *Some remarkable varia... the height and temperature of the tropo... found in Indian sounding balloon record...*

November 29, 1940. C. G. PENDSE: *S... investigations of the palæozoic floor ... England.*

1812-40—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.

THE INSTALLATION CEREMONY

OF

HIS HIGHNESS MAHARAJA

SRI JAYA CHAMARAJA WADIYAR BAHADUR

MYSORE

HIS HIGHNESS MAHARAJA

SRI JAYA CHAMARAJA WADIYAR BAHADUR

ISSUED THE FOLLOWING MESSAGE TO THE PEOPLE OF MYSORE
ON THE OCCASION OF HIS PATTABHISHEKAM

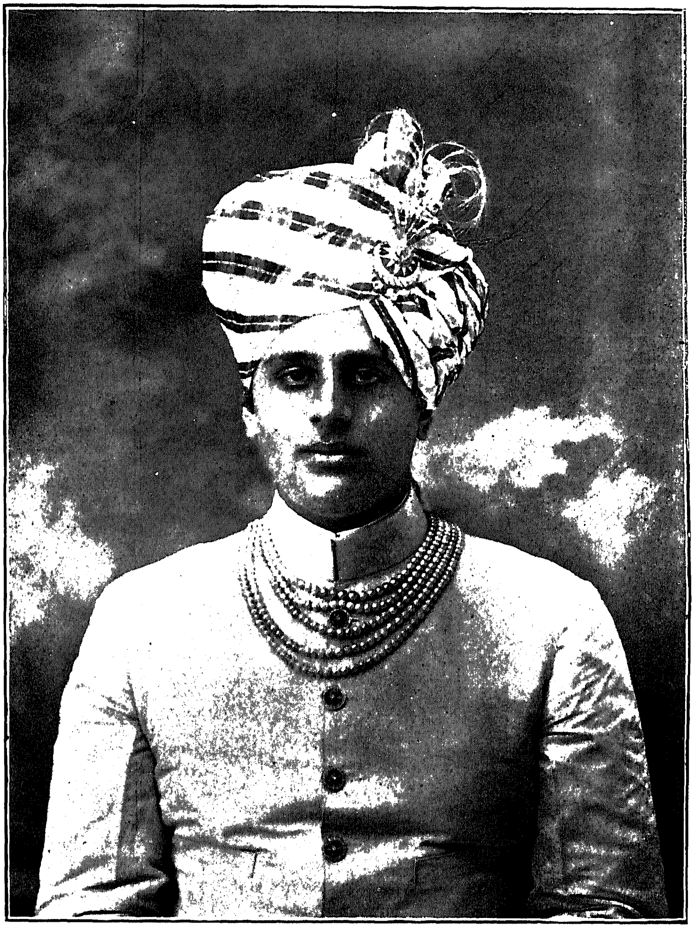
My Beloved People,

I have been profoundly moved by the innumerable marks of respect and affection for my revered uncle, the late Maharaja Sri Krishnaraja Wadiyar Bahadur, which have poured in from the rich and the poor, from high and low, and from every quarter of the State. Such testimony to the loss, which they as well as I have sustained, has brought much consolation to me and to the members of my house, and will be a source of strength to sustain me in the great task upon which I am about to enter. In succeeding to the Throne of Mysore, I follow a great Ruler who loved you all, and who won your love by his love of God, his wisdom, his graciousness, his humility, his faithfulness to duty and his kingly greatness. His memory will be ever with us. It is a bitter memory now, when we are feeling the full shock of his loss. The gap he leaves in all our lives will grow sweeter as years go on and as we learn to appreciate the more all that he meant to us and to mould our lives by his. It is now for us to dedicate ourselves to the fulfilment of his great task, and we shall succeed in fulfilling it, if we so consecrate ourselves in the spirit of one great family.

The world is very full of troubles to-day, and it is only by meeting these troubles in a spirit of unity and self-sacrifice that we can win through. In this spirit, I look upon this ceremony of ascending the Throne of my ancestors as a dedication of myself, my life and all I have to the service of the people of Mysore, but I am fully conscious that no effort of mine can succeed alone. I need your help and your co-operation, your confidence and your love. May God grant me light and strength in the discharge of the sacred duty entrusted to me, and may His blessings in abundance rest on and brighten every hearth and home in Mysore.

THE PALACE, MYSORE,
8th September 1940.

JAYA CHAMARAJA WADIYAR.



HIS HIGHNESS MAHARAJA

SRI JAYA CHAMARAJA WADIYAR BAHADUR

SUPPLEMENT TO "CURRENT SCIENCE"

Vol. IX] SEPTEMBER 1940 [No. 9

HIS HIGHNESS MAHARAJA SRI JAYA CHAMARAJA WADIYAR BAHADUR

According to predictive astrology the conjunction and the relative disposition of certain planets in the Zodiac offer the most auspicious occasion for the performance of the prescribed *shastraic* ceremonies and the installation of the king on the *Gadi*. Such a propitious moment occurred on Sunday, 8th September 1940, at 10-30 A.M., when, after the due solemnization of the formalities, His Highness Maharaja Sri Jaya Chamaraja Wadiyar Bahadur ascended the jewelled throne of his ancestors, amidst scenes of pomp and general rejoicing.

His Highness was born on 18th July 1919. The education and bringing up of the young prince was an object of constant solicitude to his uncle and his father who devoted personal attention to minute detail. An English gentleman of wide experience, Mr. J. T. Turner, was appointed for the purpose of teaching and general supervision, with a staff of tutors for guidance in formal studies. Leading a regular and healthy life under kind but strict discipline, the prince, who displayed a natural and precocious disposition towards learning, made rapid progress. It may be said that even this early education and training were directed to induce such a healthy tone of mind and body as to prepare him to fill with credit and distinction the place of eminence and responsibility, which he would in the future be called upon to occupy. Later he proceeded to keep his terms at the university, where his intellectual and social gifts soon earned for him the popularity and esteem of his professors and fellow-students. An educational institution is an epitome of the larger life of the population, and presents infinite opportunities for an observant student to study those intricate conditions and problems which perplex and press hard on the public. Eager and assiduous as the prince was in pursuing his studies in history, economics and politics for his degree examination, he was equally zealous and diligent in gathering first-hand knowledge of the tendencies, the outlook and the aspirations of his class-mates, with whom he freely moved, while participating in the extra-mural activities of the university. The academic discipline accruing from a steady application to acquiring knowledge in the different branches of learning is in itself an invaluable asset, but the steadying and stimulating influence which the living environment of the university in all its several aspects, exercises over the young receptive mind, is far more fundamental in establishing the best traits of character. College days are a glorious time; college games and debating societies are the charter of students; all healthy-minded scholars leave the college in a flood of tender emotion, carrying with them the traditions of the old place to inspire the energies of manhood. The period of four years spent at the university must have enabled His Highness to bring back

happy recollections of his efforts in enriching his knowledge and in widening his experience through social intercourse, as it must have been undoubtedly a privilege and distinction for his fellow-students to be associated with their future ruler in a spirit of healthy competition in their daily work. In the sense of Cardinal Newman he was popularly known as gentleman prince at the university.

After taking his degree of Bachelor of Arts, His Highness was associated with Mr. D. H. Elwin, an experienced officer from Madras, in the study and investigation of the administrative affairs of the State, the problems affecting the rural population and the condition and standard of life of the common people. A programme of tours in the districts was accordingly arranged, which enabled His Highness, through the assistance of local authorities and heads of departments, to work his way through the granite of these difficult subjects. In his journeys to Japan and to Great Britain, His Highness must have enjoyed excellent opportunities of visiting public institutions, coming into intimate contact with the leaders of public life and of studying the economic, social and political organisations of these progressive countries, which, besides exercising a wholesome influence on the keen intelligence and apt capabilities of the young prince, must have produced a sympathetic open-mindedness to new ideas and ideals. The advantages of formal discipline in humanistic studies at the university have been great, the quickening influences of self-education acquired during travels must have enriched and fortified that discipline, but by far the most potent factor in moulding the thoughts and character of the young Maharaja was the spirit and influence of his illustrious *Mahatmic* uncle and the catholic temper and the genial disposition of his great father. Endowed with such excellent gifts, polished by independent impulses of different origins and by men of eminent characters, His Highness Maharaja Sri J[...] Chamaraja Wadiyar Bahadur has assu[...] the reigns of Government.

Mysore is on the eve of inaugura[...] important constitutional reforms, frame[...] accordance with modern notions and mo[...] requirements, by which the popular ele[...] will have wider opportunities of co-opera[...] with the government in its legislative [...] administrative functions. The policy of [...] new administration which His Highness [...] hereafter direct is admirably enunciate[...] the few noble and significant sentence[...] the message which he issued to his p[...] on the occasion of his installation:

> "I look upon the ceremony of ascen[...] the throne of my ancestors as a dedic[...] of myself, my life and all I have to [...] service of the people of Mysore, but I [...] fully conscious that no effort of mine [...] succeed alone. I need your help and [...] co-operation, your confidence and [...] love."

The ground is well prepared. It [...] to us that the present occasion is approp[...] for taking stock of the progress made [...] Mysore in some of the important fiel[...] administrative activity during the last [...] years, which would enable the disce[...] public to visualise the potentialitie[...] future advancement; and with this view [...] have invited the authorities of ea[...] departments and important leading cit[...] to contribute articles which form the [...] feature of this Supplement.

At the head of the administration M[...] has a Dewan whose devotion and loyalty [...] the Ruling Family are as spontaneous [...] abiding as his eagerness and enthusiasm [...] promoting the welfare and prosperity of [...] people are profound and sincere. The e[...] and drive which Sir Mirza Ismail ha[...] parted to the administrative machinery [...] acquired for the civil service such a [...] tation for purity and efficiency, that [...] attracted a large number of ruling p[...]

to Mysore to be trained in the theory and practice of administration. The value and importance of this permanent service to the State do not lie merely in its vigilance, integrity and loyalty to traditions, but arise from its receptivity to new ideas and flexibility of mind. By outlook, training and technique this machinery is competent to discharge its duties at the tempo demanded by the new constitutional changes in the administration of the State. The growing recognition of the fact that the complexity of the task of administering the State makes demands both on the government and the people, has created a new spirit of mutual understanding and co-operation, for which the recent developments in the economic and industrial spheres and the extensive organisation of medical relief afford significant evidence. Comprehensive and beneficial as these activities are, they form a prelude to the new administration for the achievement of still greater and still more enduring works of public utility for which the people are impatient, and which the Government have the necessary vision, and vigour to elaborate into the detail required.

The cardinal basis of the administration of the State has been the recognition of the fact that, if the full possibilities of government are to be achieved, if government is to grow and develop, if it is to retain vitality without acting as a barrier against a living current, the State must serve its citizens wisely within the limits of the constitutional system, and that the citizens must cheerfully and unstintingly co-operate with the efforts of government. The capacity of the citizens at once to serve the government and to be guided by it, and thus to make of government a living partnership, is dependent upon a wider, more explicit and more continuous understanding of the public of the fundamental concerns upon which both government and the life of the citizens are predicated. It is this reciprocal contribution of government and citizens that gives vitality to the State. The progress made in this department of statesmanship is due to the wisdom and sagacity of His late Highness Maharaja Sri Krishnaraja Wadiyar Bahadur, guiding the hand of his minister Sir Mirza Ismail in the administration, which is the making of modern Mysore. We stand too near to be able to gain a proper and adequate perspective of the principal achievements within recent times, but when history composes her chapters on them, she will perhaps assign to these events a place comparable with the brightest period of Abul Fazl and Todar Mal. His Highness Maharaja Sri Jaya Chamaraja Wadiyar Bahadur has come by this glittering heritage, and may Providence enable him to place the State on a pedestal of higher glory.

We shall now introduce the articles.

THE FACILITIES FOR TRAINING IN ADMINISTRATION OFFERED BY THE STATE OF MYSORE WERE UTILIZED BY THE FOLLOWING PRINCES

HIS HIGHNESS THE RAJA OF NARASINGHAR.

THE YUVARAJA OF MUDHOL.

HIS HIGHNESS THE MAHARAJA OF TRAVANCORE.

THE THAKORE SAHEB OF RAJKOT.

THE RAJA OF NAGOD.

HIS HIGHNESS THE NAWAB OF JANJIRA.

THE YUVARAJA OF DEWAS (Senior).

HIS HIGHNESS THE RAJA SAHEB OF AKALKOT.

HIS HIGHNESS THE MAHARAJA, SCINDIA OF GWALIOR (during minority before assuming powers).

THE RAJA KUMAR MANSINGH OF BANERA (Mewar State).

THE MIR OF KHAIRPUR.

PRINCE APPA SAHEB PANT OF AUNDH STATE.

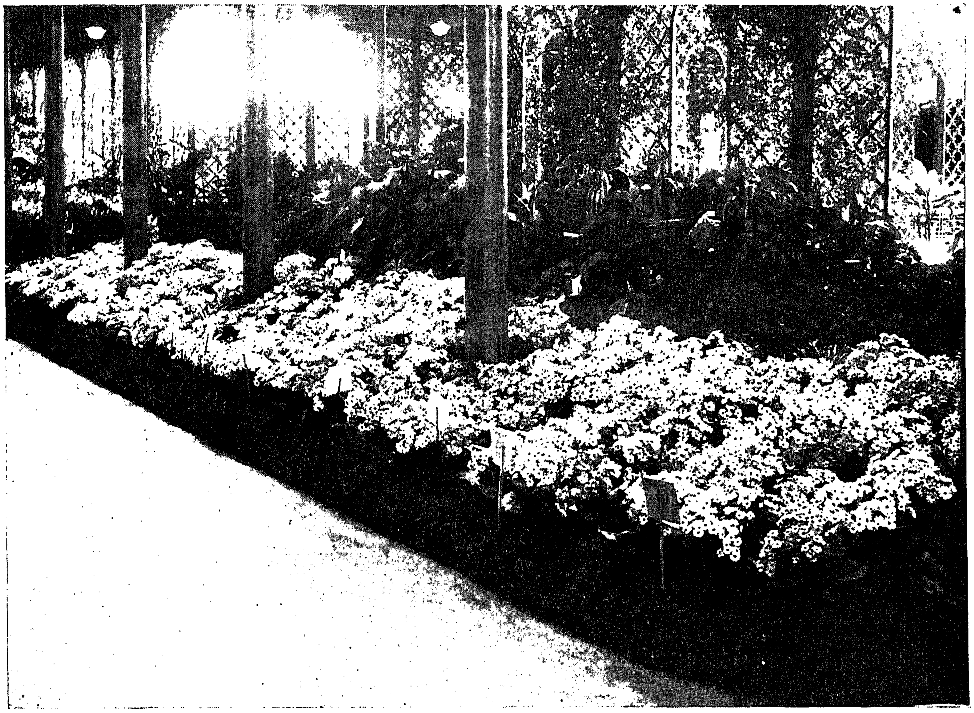
THE MAHARAJA KUMAR CHANDIKESWARA SARAN SINGH DEO OF SURGUJA.

THE YUVARAJA OF JIND.

THE THAKORE SAHEB MINOR CHIEF OF KOTDA SANGANI.

THE RAJAKUMAR LAKSHMI NARAYAN BHANJI DEO OF KEONJHAR STATE.

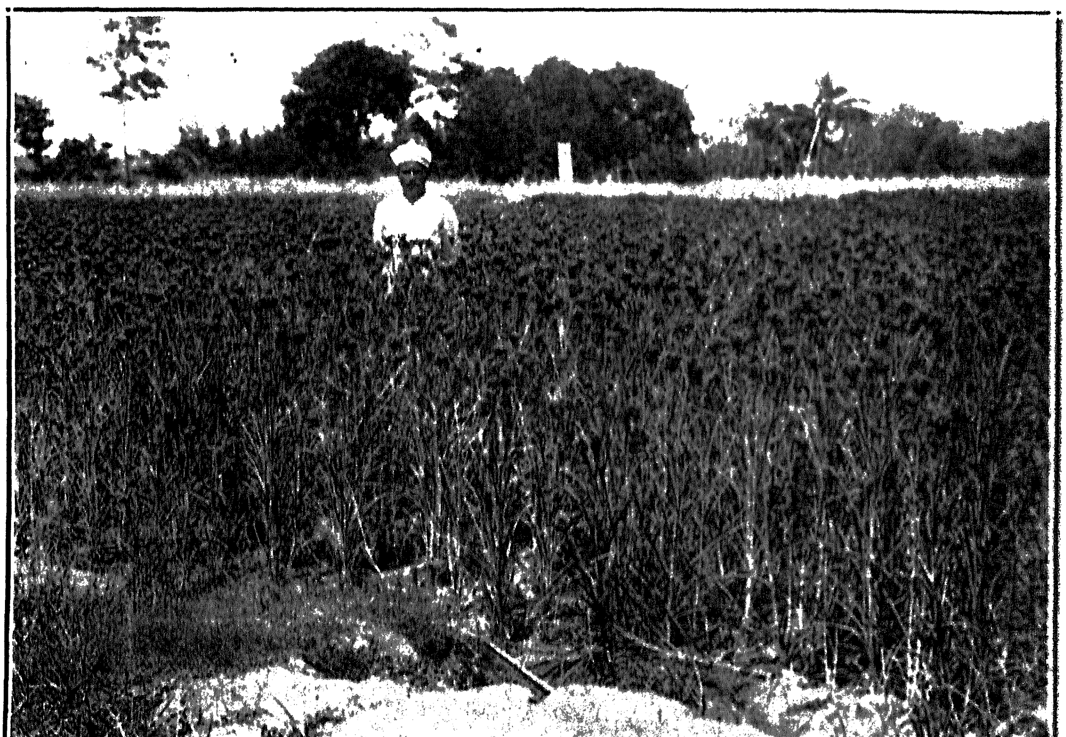
HIS HIGHNESS THE MINOR MAHARAJA OF DHAR.



GOVERNMENT GARDENS, BANGALORE

H.M. 661 SUGARCANE, HEBBAL

M.H. II COTTON, MALLEHALLI, CLOSEPET



K. I RAGI, NELAMANGALA

INCREASE OF AGRICULTURAL PRODUCTION

THE greatest service to the country where over 85 per cent. are engaged in agriculture is the increase of agricultural production. The raiyat is the primary producer of the country's food, clothing and wealth directly from the natural resources of soil and rainfall. All manufactures and the learned occupations depend for their welfare on the efficiency of the raiyat's cultivation. Every industry has its laboratory engaged in investigation of methods of increasing the quantity, improving the quality, and reducing the cost, of production. That laboratory for the farmer is the Department of Agriculture and its utility depends upon the directness of its solutions to the farmer's problems and the speed of the transmission of these solutions to his routine of cultivation. A very brief critical review of the work of the Mysore Agricultural Department in very recent years in solving the farmer's problems will be attempted here.

The most important factor for success in solving the farmer's problems is to secure the closest correlation between fundamental research of the scientific sections, the conduct of field experiments in the Experimental Farm and demonstration in the raiyat's field. These three links in the chain are in the hands of different sets of persons with different outlook, experience and aptitude, and the secret of success of the Department lies in the proper direction of the energies of these three different sections to one common goal. Briefly stated, the fundamental problems of agriculture in Mysore are firstly how to increase production so as to reduce the deficit of raw agricultural produce in essential commodities and secondly how to increase the production of money crops for local needs and export. The greatest deficit of agricultural production in Mysore is rice and cotton of the value of nearly a crore of rupees each and pulses to the extent of nearly 40 lakhs a year. The main agricultural problem is thus how to produce more rice, more cotton, more pulses, more oilseeds and sugar.

Out of nearly 65 lakhs of acres in Mysore under actual cultivation, perennial crops like cocoanut, arecanut, coffee and cardamoms, mango, etc., occupy less than ten per cent., and out of the balance of area nearly 80 per cent. is under dry cultivation. Dry cultivation therefore offers the largest field for increasing the wealth of the country. The crops grown in Mysore in the dry area are cereals (*ragi, jola* and other millets) comprising fifty per cent. of the total area under cultivation, pulses like *avare, togari*, horsegram and money crops like cotton, groundnut and oil-seeds. The fundamental problem for the dry-land farmer is to secure improved seeds of cereals so as to produce the country's food requirements on a smaller area than now so as to release larger area for cotton, pulses and oil-seeds. The human population of the State being about 70 lakhs, the population of ploughing cattle being only 12 lakhs, and the acreage under cultivation being 65 lakhs, the problem in dry cultivation is how to grow more per acre rather than the extension of cultivation which is limited by the population of men and cattle. In wet cultivation the problems of the farmer are how to increase the production of rice, sugarcane and irrigated cottons in the area available.

It would be interesting to examine the work of the Agricultural Department in very recent years with reference to the country's problems as set forth above. The easiest method of increasing production is the use of improved seed as it involves the least cost for securing increased production and is thus suited to the poorest man. It involves no change of the raiyat's methods of cultivation. It is the easiest to demonstrate to the raiyat as you have only to supply him the improved seed. It is also the easiest method for transmission of the benefit from raiyat to raiyat. The improvement once effected at practically no cost lasts year after year automatically without any effort. Hence the production of improved varieties of seed by plant-breeding and its distribution to the raiyat is the largest single factor contributing to increase of production. A reference will therefore be made to the contribution of the plant-breeding department to increase production per acre.

Paddy.—The deficit in the production of paddy in the State is estimated at 15 lakhs of pallas costing nearly a crore of rupees. The area under paddy is estimated at 8 lakhs of acres. It is thus clear that an increase of two pallas per acre in production would

enable the State to avoid the annual deficit of rice and prevent the drain of a crore of rupees per annum from the State. The increase of two pallas per acre in production in the course of about ten to twenty years is within the range of practical politics provided of course, that a sustained application of funds and the efforts is forthcoming. The Paddy Specialist of the Department has evolved very high yielding strains of paddy of good quality and high milling percentage. Innumerable testimony of the growers proves the possibility of producing at least two pallas more per acre. Among monsoon paddies Selection 661 fine and 699 medium evolved from G.E.B. 24 (Coimbatore Sanna) are in such extensive demand from raiyats on account of their higher yield and value that the Department is working hard to meet the enormous demand for seed. Selection 705 fine from Bangarakaddi and Selection 396 coarse, better known as Hebbal 3 months paddy, Chintamani Sanna 547 and Halubbalu 317 offer a very high yielding shorter duration paddies for summer. Several interesting crosses between Ganasale and G.E.B. 24, Nagpur Sanna and G.E.B. 24 to produce a variety with high yield, good milling percentage and non-shedding habit are in different stages of progress.

Asiatic Cottons.—The Mysore State has a black cotton soil area of over a lakh of acres for the cultivation of Sannahathi or Asiatic cottons mostly in the Chitaldrug and Mysore Districts and an unlimited area under red loamy soils for Doddahathi or American cottons. From the original Sannahathi of the Chitaldrug area, a pure-line selection S. 69 was evolved for higher yield, ginning percentage and better spinning quality. Sel. 69 has extended over nearly 20,000 acres in recent years. The late Economic Botanist, Mr. V. N. Ranganatha Rao, a very talented cotton-breeder, produced a very fine cross between Sel. 69 and *G. arboreum* known as H. 190, with a ginning percentage of 30, a spinning quality up to 30's warp-counts and an yield of nearly 8 Mysore maunds per acre. This is an excellent improvement on S. 69 securing to the grower an appreciable premium in price. This was released only three years ago for general cultivation but has already extended over about three thousand acres. By crossing H. 190 with another of his crosses C.N. 4-5 Mr. Ranganatha Rao has left behind an ideal cotton with very high ginning percentage, wilt resistance a… spinning quality. By a statistical … experiment for determining the optim… distance between the rows of cotton it … been proved that the yield of cotton per a… can be increased by nearly 20 per cent. … simply reducing the distance between r… from 3' to 2'. By combining reduction in … space between rows and change of seed … H. 190 the raiyat's income per acre in … Chitaldrug cotton area is shown to be capa… of being increased by nearly thirty per c… It was also demonstrated last year in … field of a raiyat that cotton production … the T. Narasipur area can be increased … to 40 per cent. by substituting our H. … in place of local Karunganni cotton.

New World Cottons. The black cotton … area in the State being limited, the grea… future lies before Mysore State in the cu… vation of Doddahathi or American cotton… the millions of acres in the Maidan Distr… The late Mr. Ranganatha Rao evolved … excellent cotton M.A. 2 by hybridising … Doddahathi with a Peruvian tree cotton … is better suited to the areas in which … is grown than ragi itself. It is approved … the Spinning Mills at Bangalore to be a … grade medium staple cotton. It is capab… yielding upto about 600 lbs. of seed co… per acre if sown in May in dry areas … about 1,000 lbs. per acre if sown in Feb… or March under irrigation. The further … provement of M.A. 2 by selection … hybridisation to improve staple length … ginning percentage is in progress. With … aid of funds sanctioned by the In… Central Cotton Committee a new long-sta… cross Co. 2 X Uganda with high gin… percentage has been evolved and is … multiplication. Promising crosses betw… M.A. 2 X Peruvianum and Co. 2 X Peru… num are in several stages of progeny.

Sugarcane. Under the Thick Cane Bre… ing Scheme financed by the Imperial Co… of Agricultural Research new sugarcane… very high economic value have been evo… and are under critical statistical tests … multiplication. The performance of the … of them as against the best standard … Co. 290, Co. 419 and H.M. 320 is … in the table below.

H.M. 661 is a very bold cross betw… Co. 281 and Teosinte and is the most pr… ing of new canes. It promises to yield …

No.	Variety	C.C.S. in tons per acre	Yield of cane in tons per acre	Brix % N. T.	Sucrose %	Glucose %	Purity %	Fibre in Cane %	C. C. S. %
1	H.M. 661	5·23	40·2	20·50	19·20	0·38	93·66	17·60	13·02
2	,, 657	5·09	45·5	19·30	17·30	0·50	89·64	19·00	11·18
3	,, 656	4·69	37·0	20·50	18·80	0·35	91·71	17·05	12·08
4	, 651	4·66	39·1	20·90	18·90	0·30	90·43	21·00	11·93
5	,, 658	4·52	39·7	19·60	17·30	0·73	88·26	17·09	11·38
6	C.O. 290	4·37	36·3	18·90	17·00	9·62	89·95	12·72	12·03
7	,, 419	4·35	33·2	20·60	18·65	0·59	90·53	13·52	13·10
8	H.M. 659	4·34	36·1	19·90	17·50	0·62	87·94	13·80	12·02
9	,, 654	4·27	36·1	20·60	18·00	0·83	87·38	16·70	11·83
10	,, 320	4·26	32·3	20·00	18·44	0·48	92·25	13·10	13·19

more sugar per acre than the present standard canes. It is a very vigorous cane which has been found to grow well under varying conditions of soil and irrigation.

Ragi.—Several new strains of ragi were tried during the last three years. Among the early varieties, that is, with a duration of 3 months from the date of transplantation, K_1 ragi of Mysore and E.C. 3735 of Madras have been found to be the best. In the varieties of medium duration, that is, about 4 months, E.S. 4, E.S. 11 of Mysore and E.C. 593 of Madras have been found to be the best. Among the late varieties, that is, with a duration of 5 months, H. 22, Dharani ragi and Konanakombu have been found to be the best. All these are far superior to the local ragies. Of all these E.S. 4 was found to give the highest yield of 10¾ pallas of ragi per acre when tried by one of the most progressive raiyats near Bangalore. Limitation of space in this article does not permit of reference to the selection work done in the other crops but the most interesting work has been done on groundnuts where a very wide range of crosses from those which yield the highest quantity of nut to those which yield the highest quantity of green leaves, have been evolved. An interesting variety of groundnut which grows to a height of 2 ft. is promising for fodder and green manure.

A very large number of manurial experiments on different crops were laid out in statistical pots with the object of reducing the cost of production per acre. The raiyats who are superficial have the impression that manuring adds to the cost of cultivation. This is only literally true as judicious manuring reduces the cost of production per ton of the crop. The manurial dose adopted for sugarcane in the Irwin Canal Farm yields 10 times more cane than in the unmanured plot. Seeing that the cost of cultivation other than manuring is the same between the two, the advantages of judicious manuring are only too obvious. New manurial formulæ have been fixed after a series of statistical trials to secure yield and quality of cigarette tobacco and several other crops. The manurial formula adopted for paddy has in many cases increased the yield by 25 per cent. The manurial formulæ for different crops have been compiled and published recently in a bulletin.

Among successful cultural experiments the most important is the intercultivation of ragi and cotton which was demonstrated last year for the first time in the Rural Welfare Centre, Closepet and which has been adopted over hundreds of acres in that Taluk. This new cultural practice has a great future as increasing the raiyat's income from dry land and increasing the production of cotton in the State. This practice is capable of extension over millions of acres.

Live-Stock.—The improvement of live-stock is no less important than improved strains of crops or application of manures as soil tillage is the most important factor

in the success of cultivation. Cattle rearing is the most important subsidiary industry of the raiyat as Mysore supplies ploughing cattle to the adjoining districts of British India. The fiery Amrit Mahal wild breed of cattle originally reared for military transport is being domesticated to serve agricultural purposes. In addition to the Ajjampur Cattle Breeding Station for 1,000 cattle the Hunsur Cattle Breeding Station was started last year for 500 cattle. The supercession of the ranching system by the farming system has very greatly improved the condition and growth of the cattle. A very large number of bull-calves are sold for breeding purposes at concession rates to cattle-breeders.

Sheep-breeding is an important subsidiary industry essential to agriculture for the sake of the manure. There are nearly three million sheep in Mysore but their economic value at present is only in the value of the carcase and manure. The wool-yield is barely ½ a pound per head per annum valued at 4 annas a pound. By cross-breeding with Merino the wool yield is raised to 3 lbs. per annum valued at 12 annas a lb. To accelearte cross-breeding a pure-bred Merino flock has been imported from South Africa. Orders have also been placed for Corriedale sheep. Sheep Breeders' Associations are working in Kolar and Mysore and a new one will soon start work at Channarayapatna. The Yellachihalli Sheep Farm for indigenous sheep and the Ajjampur Sheep Farm for cross-breds supply stud rams to raiyats.

Poultry-farming is a very lucrative subsidiary occupation. White Leghorn hens lay an average of nearly 200 'A' grade eggs a year valued at 12 annas a dozen while their cost of maintenance is only Rs. 3 per annum. Rhode Island Reds are a dual purpose breed. A hen of this breed lays in the average about 170 to 180 'A' grade eggs a year valued at 12 annas a dozen while the cost of maintenance is only about Rs. 4 per annum. For demonstration and supply of hatchable eggs, chickens and table-eggs, ten poultry farms have been opened in several parts of the State.

Bee-keeping.—Bee-keeping is a very useful subsidiary industry which involves no cost whatever except providing hives for the bees. During recent years six demonstration centres with several bee-colonies in each were being conducted and propagandists are demonstrating improved methods of bee-keeping. One tangible result of this work is the starting of a Bee-keepers' Co-operative Society at Saklespur with 500 improved bee-hives in addition to a large number of pot-hives which are gradually being replaced by box-hives. Within six months of its starting it has collected 7,000 lbs. of honey from its members and clients.

Demonstration.—The most important work of the Department during the last three years is the development of demonstration work, that is, the extension of the benefits of research to the raiyat's field. Nearly 4,000 demonstration plots are laid annually in raiyat's holdings to convince him that even with his present methods of cultivation higher yields of produce can be obtained by mere change of seed to improved varieties or by altering the manurial dose. The net result has been an enormous increase in the demand for improved varieties of seed. The allotment for purchase and distribution of seed four years ago was Rs. 10,000. In three years, that is 1939–40, five times that allotment was found inadequate. The quantity of improved seeds of paddy and cotton distributed last year is nearly 5 times the quantity distributed four years ago. Here is unimpeachable evidence of the contribution of the Department's work to the increase of agricultural production in the State and an unimpeachable testimony of the raiyat to the usefulness of the service rendered to him by the Department. In view of the difficulty to meet the enormous demand for improved seed, seed farms are being organised locally all over the State. If proof of the pudding is in the eating, proof of the usefulness of the Department is in the thirst for improved seed.

T. G. RAMA IYER.

THE CO-OPERATIVE MOVEMENT IN MYSORE

THE Co-operative Movement was introduced in the Mysore State by the Government of Mysore in 1905 after the Mysore Co-operative Societies' Act was placed on the statute book of the State. The object of the government was to assist the formation of co-operative societies which had as their aim the promotion of the economic interests of their members and the inculcation of the habits of thrift and self-help among agriculturists, artizans and persons of limited means. The first Co-operative Society registered under the Mysore Act was the Bangalore City Co-operative Society, a combined stores and credit society. The Act was amended in 1918 mainly on the lines of the Government of India Act of 1912, and more recently in 1929 to facilitate the formation of Land-mortgage Banks; in 1933 for making provision of a better administration of the societies and for exercising an effective control over their working; and again in 1935 for further facilitating the working of the Land-mortgage Banks and Societies.

General Progress.—The progress of the movement in the State may be divided into four distinct stages. The first stage covers the years 1905–12 when the ground was prepared by continuous propaganda and a few societies were formed here and there. At the end of 1911 there were 111 societies, with a membership of 9,043 and a total working capital of Rs. 3,71,194. The second stage which may be said to have continued up to the end of 1920–21, witnessed the establishment of 1,500 societies, with a membership of 92,121 and a working capital of Rs. 78·19 lakhs. As the movement had to face knotty problems of a varied character requiring expert advice and solution, government were pleased to appoint a committee of enquiry under the chairmanship of the late Sir Lalubhai Samaldas Mehta of Bombay. The Committee's Report was published in 1923. The third stage of progress was reached and a policy of consolidation of the movement coupled with cautious expansion was pursued for another five years, *i.e.*, till the end of 1925 when there were 1,474 societies with a membership of 91,602 and a working capital of Rs. 92·22 lakhs. By this time the after effects of the 1914–18 War on the world economic conditions were markedly seen. Commodity prices soared high and land values mounted up and the agriculturists were in a prosperous condition indeed. A policy of further expansion coupled with the establishment of land-mortgage banks was pursued and by 1930–31 there were 2,213 societies, with a membership of 1·38 lakhs and a working capital of Rs. 1·89 crores. With the appearance of the economic depression in 1930–31, the fourth stage of the movement was reached and a policy of consolidation and rectification coupled with the weeding out of societies having no life in them was pursued. A Committee of Enquiry was appointed in 1935 with Diwan Bahadur Rajadharmapravina Mr. K. S. Chandrasekhara Iyer, B.A., B.L., Retired Chief Justice of the High Court of Mysore. At present there are 1,895 societies with a membership of 1·4 lakhs and a total working capital of Rs. 2·7 crores.

The largest number of societies are agricultural credit societies. They number 1,436 with a membership of 64,000 and a working capital of Rs. 58·78 lakhs. Their main function is to finance the agriculturists for short-term and intermediate requirements with the help of the Apex Bank. The Land-mortgage Bank and societies are meant for financing the agriculturists for the redemption of their prior debts. The Mysore Central Co-operative Land-mortgage Bank was started in 1929 and it finances the members of primary land-mortgage societies through them. The Bank has at present a membership of 207 (inclusive of 39 land-mortgage societies) and a paid-up share capital of Rs. 1,09,000. The Bank's working capital is raised by the floatation of debentures guaranteed by the Government of Mysore both for principal and interest. The amount of debenture capital raised up to date is Rs. 11·5 lakhs. It has sanctioned loans to the extent of Rs. 14·06 lakhs in 1,215 cases of which 12·61 lakhs have been disbursed. The Land-mortgage Societies which are at present operating in 40 taluks, 4 sub-taluks and portion of three taluks have a membership of 5,928 and a share capital of Rs. 1,25,700. The Land-mortgage Scheme is being gradually extended and it is expected that ere long there will be a net work of

land-mortgage societies operating throughout the State.

Non-credit Agricultural Societies.—With a view to remedying the main defect of the movement which is more or less one-sided now, credit preponderating and to make it subserve the needs of the agriculturists more largely, the attention of the Department has been diverted to the development of non-credit activities. The Plantain Growers' Marketing Society organised at Hiriyur has done good work and promises to do better. The Ganjam Figs Marketing Society has enrolled 69 members and during the year it has been able to sell 80,697 fruits co-operatively. The Malnad Fruits Marketing Society has sold over 4 lakhs of oranges during the year. The Bee-keepers' Society at Saklespur has enrolled 39 members and collected 6,000 lbs. of honey and is attempting to solve the question of a good market for the honey. It has indirectly helped the development of apiculture in the Taluks of Saklespur and Belur. The Malnad Areca Marketing Co-operative Society has enrolled 662 members and handled 26,000 maunds of areca during the year. Spraying materials worth Rs. 12,000 have been advanced by the Agricultural Department to the members of this Society. The Nuggehalli Cocoanuts Marketing Society has just commenced its operations. The work of distributing good cotton seed has been continued in the credit societies in the Chitaldrug District and the Maradihalli Co-operative Society is leading in this direction. This society handled during the year 26,855 maunds of cotton. One Adikarnataka Society collected 150 pallas of neem seeds for sale co-operatively. It also arranged for training being given to its members in poultry farming, tanning, button manufacturing and mat weaving and the question of introducing such work in a few more societies is engaging attention. An egg marketing society has recently been formed at Dodballapur. The work relating to the stocking and supply of kole-roga sprayers and materials has been tacked on to a few rural societies in the Koppa and Sagar Taluks and Sringeri Jahagir Taluk. The Potato Growers' Marketing Society formed at Ramagondanhalli in the Bangalore Taluk is progressing and the co-operative sale of ragi, paddy, jaggery, eggs and other crops of commercial importance is receiving attention. Organisation of multi-purpose societies and the tacking on of multiple activities to the existing credit societies, wherever conditions are favourable and proper personnel to manage the concerns efficiently are available, is being pursued. These measures, it is trusted, will create a better atmosphere for the formation of village banks catering to all the needs of the villagers, envisaged by the authorities of the Reserve Bank of India.

Urban Co-operative Banks and Societies.—Societies situated in the Cities of Bangalore, Mysore and Kolar Gold Fields, the District and Taluk Head-quarters places are classed as urban. Though the Co-operative Movement was introduced primarily for the benefit of the agricultural classes, the first society registered under the Mysore Co-operative Societies' Act is the Bangalore City Co-operative Society, Ltd., which is a combined banking and consumers' society. The fairly successful working of these urban institutions is mainly due to the availability of the requisite human material to run them and also to the fact that the principles of co-operation and banking are easily understood by the town-dwellers, being generally more literate than their brethren, living in the rural areas. The membership is largely drawn from the salary earners, the followers of the professions such as law and medicine, merchants, contractors and labourers. While a large percentage of members of these societies consists of the servants of Government and the Municipalities, salary earners' societies for the benefit of the employees of particular public offices, commercial concerns and mills are also in existence side by side. It has to be admitted that urban life is characterised by lack of mutual knowledge, diversity of occupation, a more or less developed business instinct and egoistic tendencies, which are not quite conducive to co-operative consciousness. But though the urban societies are lacking in co-operative character in that there could be no mutual knowledge and no mutual control, they have fared better than their rural counterparts and have taken their rightful place in the economic life of the town-dwellers. There are 360 urban societies in the Mysore State with a membership of over 70,000 and a total working capital of Rs. 1·30 crores which is nearly half the aggregate working capital of all classes of societies in the State.

Judged by their financial strength—they do not stand in need of finances from the

Apex Bank or Government—these urban banks have done very well indeed. They had, on 30th June 1939, 70,000 members and a total working capital of Rs. 1·30 crores. The foremost object of Urban Banks and Societies is the development of thrift among their members and it is indeed an achievement that these institutions have a paid-up share capital of Rs. 34·50 lakhs and hold deposits aggregating to Rs. 68 lakhs. While it is no doubt true that the bulk of the deposits has come from non-members or from the well-to-do among the members, and the average man's deposits are few, that they have been able to tap the local capital and make it available for being advanced to the members at reasonable rates of interest and easy terms of repayment, is in itself a remarkable achievement. Along with the development of thrift, though to a small degree, these institutions have created a sort of banking consciousness among the people. The use of cheques and the opening of current and drawing accounts in many societies and the transfer of funds from one place to another by means of such cheques have been helpful to trade.

Consumers' Movement.—Besides the credit movement, the urban areas have a large number of full-fledged consumers' societies to serve their members' needs in the sphere of the supply of the necessaries of life. There are 68 such institutions with a membership of over 16,000, the annual sales amounting to nearly Rs. 15 lakhs. These societies are combined credit and stores societies and represent a distinct feature of the Mysore Movement. Sales are for cash as well as on credit. Prices are not subject to the fluctuations of the market. These may appear very strange to the orthodox co-operators who pin their faith to the principles laid down by the Rochdale pioneers. But the fact that the societies have not suffered by the rapid fall in commodity prices and were able to weather the storm successfully during the economic depression, indicates that the slight departure from the orthodox principles may not after all be a stumbling block in the working of the consumers' societies.

One of the most important functions of the movement is the cheapening of the capital to such a degree as to make it available to the poorest among the society on terms which are within his resources to fulfil. That the general rate of interest on loans has been brought down so low as 6 per cent. is an achievement of which the co-operators may well feel proud. But the urban population of the State is over 10 lakhs and the number of persons brought within the co-operative fold is only 70,600, which on the assumption that a member represents a family of five persons indicates that about 35 per cent. of the urban population is served by the movement. Even after an allowance is made for multiple membership, it can safely be put down that 25 per cent. of the town-dwellers enjoy the benefits of co-operation. When it is remembered that the money-lender particularly the Pathan, the Marwari and the Multani are, in spite of the existence of so many banks—joint stock as well as co-operative—still thriving and having a prosperous trade in their profession, the vast field that has yet to be covered by the Co-operative Movement becomes apparent.

The major urban societies are housed in their own spacious buildings; they maintain Free Reading Rooms for the benefit of their members and the general public; they contribute liberally out of their annual profits towards charitable objects and in aid of charitable institutions. A few have installed radio sets for the benefit of the residents of their localities.

Thanks to the early workers in the field, the movement has taken a firm root in the urban areas and there is great scope for its further development. An urban bank or a stores society necessarily implies large-scale operations and comparative economies in overhead charges. The smaller the working capital the more inefficient and ill-paid will be the staff and the more unsatisfactory will be the management. It seems therefore desirable that the smaller units in the urban areas amalgamate themselves with each other so that one efficient and well-managed institution may serve the needs of a compact Municipal Division or area, without at the same time becoming too unwieldy for efficient services to its members.

Other forms of Co-operation.—The importance of the co-operative movement among the several agencies for rural uplift has been receiving more and more recognition and full use is made of the movement for the resuscitation and reconstruction of rural life. Societies embracing all the phases

of village life are slowly coming into existence. The societies formed for the exclusive benefit of the weavers, gudigars (sandal-wood carvers) and the depressed classes are receiving special help from Government.

Co-operative Propaganda and Education.—The need for co-operative education has been realised and classes are held for the secretaries and panchayatdars of societies. Co-operative propaganda is carried on even in the distant villages of the State by means of lectures. Lectures on co-operation by the officers of the Department are a common feature of the District and Taluk Conferences. With a view to inculcate the spirit of co-operation among the student population, who are the future citizens of the State, students' co-operative societies are organised in schools and colleges with the co-operation of the Educational authorities. *The Mysore Co-operative Journal*, conducted by the Mysore Co-operative Institute, carries the gospel of co-operation to the nooks and corners of the State.

M. ABDUL HUKE

EDUCATIONAL PROGRESS IN MYSORE

THE attempt to review the progress of education in the State of Mysore during the past 15 years in a short note is not an easy task, and the following paragraphs can only hope to pick out for comment a few isolated features of the work of the Department during these years.

The total expenditure on education of all kinds in the State of Mysore (including the cost of the University of Mysore) has risen during the period under review from roughly Rs. 60,00,000 to over Rs. 70,00,000 per year. By comparison with the neighbouring provinces of Madras and Bombay or with the neighbouring States of Cochin and Travancore, it can be seen that the people of the State of Mysore have far more done for them by their Government in the matter of education than is general elsewhere. From the figures for the year 1938-39 it can be seen that practically 78% of the total cost of all expenditure in the State was met from State Funds. Fees account for only 9% of what is left and Local and Municipal Funds roughly for the remainder. It can be said with truth that there are few other places in India, if any, where Government bear so large a part of the cost of education, and where aided enterprise bears so small a portion. The State of Mysore has just cause to be grateful for the educational efforts of a number of Missionary Agencies, some of which have been working for over a century in the State, but at the same time it has to be said that the habit of self-help requires to be much more strongly developed. There is obviously a definite limit to the amount that can ultimately be found for education from State Funds, and in any extensive scheme of future expansion aided agencies will have to play a larger part than they have done in the past.

Schools fall into two main categories Primary and Secondary and in Mysore the latter category is subdivided into two classes of schools, *viz.*, Middle Schools and High Schools.

Nine years ago Elementary Education was handed over to local bodies, and it was hoped that in consequence there would be a marked expansion in the number and quality of primary schools. The local bodies were empowered to levy an education cess to augment their financial resources, and, under the Act, Government were bound to provide from State Funds their share of any such expansion. The experience of nearly 10 years has, however, proved a disappointment to the high hopes with which elementary education was transferred to these local bodies. The expected expansion has not taken place at all, and it is not either an exaggeration or unkind to say that the rate of progress is probably smaller than it would have been, had Government continued to control these schools. A Committee was in consequence recently appointed to enquire into the whole matter of elementary education, and this Committee has recommended to Government that in the best interests of elementary education Government should resume control from the local bodies. The necessary legislation in the matter is expected to be undertaken very shortly, and it is hoped that an expansion of 1,000 primary schools in the next four years will thereafter be undertaken by Government.

Middle School Education is free in Mysore State—a state of affairs which does not seem to exist anywhere else in India. Fees were formerly charged in Middle Schools in Mysore, but about 20 years ago they were abolished. This was done to encourage people, particularly those in rural parts, to send their children to Middle Schools. The gift of free education at this stage has undoubtedly been appreciated, and the response is now almost an embarrassment to Government. The present number of Middle Schools is over 350, and there are over 50,000 pupils in them. The demand for this class of school is incessant, and far outstrips any possibilities of satisfying it fully. There are demands for new Middle Schools from nearly a hundred different places in the State, and the majority of these places have no hope of having their request granted under present financial conditions. The question of the re-imposition of fees in Middle Schools is under consideration.

There is not quite the same demand for new High Schools as there is for Middle Schools, because pupils have to pay fees in

High Schools, and have also to pass the Middle School Examination before they are eligible for admittance to a High School. There has, however, been a steady increase both in the number of High Schools and in the number of pupils attending them during the past 15 years. High School education was re-organized three years ago, and special courses were started of an industrial, commercial and domestic nature, intended for pupils who do not wish to proceed to the University. It is too early to pronounce definitely upon the success of the scheme, but the experience of the first three years goes to show that there is very little appreciation among the general public in Mysore of any High School course which does not admit a pupil to the Intermediate Classes in the University. Public speakers of all kinds are accustomed in these days to refer in somewhat disparaging terms to what they are pleased to call the inadequacy of so-called "literary" education. If the experience of the attempts on the part of this State to provide alternative vocational courses is any indication, it can only be said that pupils and parents alike show little or no appreciation of any such courses, and desire nothing except a school-leaving certificate which will admit to the University.

The Mysore State was one of the pioneers in India in the introduction of Kannada as the medium of instruction in non-language subjects in High Schools. Upon this scheme also it is perhaps too early to pronounce judgment. There are far more pupils desiring admittance into the English sections in High Schools than there are places available. This question appears to be one in which people "want to eat their cake and have it". Parents do not wish their children to be weaker in English, and yet at the same time they want the advantages accruing from the teaching of subjects like History and Geography in the vernacular. Public opinion has not yet come to realise that this is one of the questions in which it is not possible "to have it both ways". In Mysore State, at any rate, Head Masters of High Schools are unable to satisfy the demand of those who wish their children to be admitted to the English sections as distinct from the Kannada sections in High Schools.

The medical inspection of school children has received considerable attention during the period under review, and recently Government have appointed a Chief Medical Inspector of Schools to co-ordinate and supervise this work. Medical inspectiton was originally confined to the children in the cities of Bangalore and Mysore, but in the last few years there has been a great expansion of medical inspection in other municipalities, which have shown a great appreciation of the value of this work, and have been willing to contribute from Municipal funds for the purpose. This year medical inspection is being conducted in over 70 municipalities—a number that is double that of last year. As more funds become available, it is hoped to provide increased facilities for follow-up treatment of pupils whose defects are noted at medical inspections.

Side by side with medical inspection has gone the provision in many places of mid-day meals for poor pupils, who come from a distance or who cannot get such facilities in their homes close-by. This is a matter in which public generosity has a wide field open to it—particularly in rural areas. Small children, who have to walk several miles to the nearest school, cannot be expected to get the maximum benefit from their afternoon lessons, unless they can get a meal of some kind at the lunch interval. In some places local people have taken up this work, but much more could be done.

E. G. McAlpine.

FORESTRY IN MYSORE

A NEW phase in the development of the State Forests was opened when in 1926 Government launched upon its policy of planned industrialisation. It was inevitable that Mysore forests should form an integral part of any such scheme. The consequence was not only that new needs had to be satisfied but better and cheaper methods had to be introduced for meeting the old demands. The rôle of forests in the economy of Mysore tended to be more important than had been before thought possible. The publication of "Some Problems of the Mysore Forest Department" in 1928 (followed a little later by "Some more Problems of the Mysore Forest Department") marked this change in outlook and perspective.

It is not easy to assess in terms of figures the progress achieved since then. In forestry there is no single yard stick which adequately measures such development. The more so in the case of Mysore where the largest single item of forest revenue, *viz.*, "Sandalwood" receipts fluctuate violently year by year, the erratic price changes produced by a number of world factors. For this reason, the net receipts from sandalwood which reached a peak figure of Rs. 24·62 lakhs in 1928–29, fell down to only Rs. 7·62 lakhs in 1938–39. The same is true of Tangadi (*Cassia auriculata*) and Kakke (*Cassia fistula*) which are used as tanning barks, the receipts from which were Rs. 7·32 lakhs in 1927–29 dwindling down to Rs. 1·32 lakhs in 1935–37. Therefore the gross forest revenue of Mysore has varied during the period 1926–40 between about 25 to some 46 lakhs of rupees. Such fluctuations are inevitable to the producers of primary raw materials. A much better index to the efficiency in the development of Mysore forests is provided by the following table, wherein are given some significant comparative statistics relating to Mysore and some of the leading Indian provinces. The figures relate to 1937–38, the latest financial year for which the information is available.

Name of Province	Percentage of surplus to Revenue	Percentage of expenditure to Revenue	Percentage of expenditure on demarcation, improvement and extension of forests compared to total expenditure
United Provinces	45	36	8·80
Central Provinces	27	40	4·2
Madras ..	15·68	58	3·3
Bombay .	37	48	3·0
Mysore ..	54	20	8·1

These results have been made possible by the systematic development over a wide front, including transport and utilisation, while at the same time particular care has been taken that this development has not been at the expense of the capital; in other words, sound sylvicultural tenets are not being sacrificed merely to reap transient monetary benefits.

Forest transport,—the essential preliminary to any forest development,—has progressed. The tramway routes in the Bhadravati forests have made it possible to make use of forest crops previously allowed to rot away. The same is true of the Agumbe Ghat forests. The success attained here has prompted a consideration of measures similarly to open the valuable Manjarabad Ghat forests in the Hassan District. One of the prime considerations in opening the Arasalu–Sagar Railway line was the transport it would provide for forest produce. The same is true of the bridge proposed to be constructed over the Suvarnavathi near Chamarajanagar, for this would open out the hundred square miles of the Chamarajanagar State Forest to the timber market at Mysore.

Mysore may well claim the credit for having pioneered the use of Balagi (*Poecilloneuron indicum*) for the use of electric transmission poles. The difficulties involved in felling these giants of the forest, in transporting them for nearly 65 miles over winding Ghat roads not designed for such traffic, were formidable; added to this were the conservatism and prejudice which had to be overcome before the poles could prove a commercial success. The same story was repeated with Dhuma (*Dipterocarpus indicus*);

it was practically an unknown timber some twelve years ago; to-day it provides tens of thousands of sleepers for railways in and out of Mysore.

The utilisation of these Ghat woods was made possible by the adoption of modern wood preservation methods. A plant for this purpose was established at Bhadravati in 1928. It was a significant event for the utilisation of the virgin Ghat timbers. Even from the purely financial point of view, the plant has already paid itself out, and is earning substantial profits. Its annual gross receipts exceed two lakhs of rupees.

A new industry was born in Mysore when in 1936 the Mysore Paper Mills were established, an industry which consumes annually some 15,000 tons of bamboos from Mysore forests. The Mysore Match Factory is the latest addition to this growing list of industries dependent on Mysore forests for their raw material. Mention may also be made of the improvisation of the departmental saw mills at Shimoga and the addition of up-to-date Seasoning Kilns—facilities which have enabled a bid to be made for the substantial market in packing shooks and cases. "Mysore makes many products, but only the best of each." It is a proud slogan. And Mysore forests have contributed their own mite to some of these products.

In the realm of minor forest products, the extension of the cultivation of lac deserves mention. The Mysore Paint and Lac Works have been extended and consume Mysore lac for manufacturing a wide variety of polishes, paints, varnishes and other lac products. In 1938–39 nearly 1,300 maunds of lac were supplied to the factory. Increasing efforts are being made to supply the local requirements of medicinal drugs. Mysore forests are rich in these herbs. Some of these are recognised by the standard pharmacopœias while a large number are popular remedies in the indigenous systems of medicine. A collection of these herbs, their identification and nomenclature have received attention as a necessary prelude to their more systematic exploitation. Some 300 of these authentic specimens have been listed. Government has also appointed last year an authoritative Committee to go into the question. Attempts are also under way to cover Mysore's requirements of quinine by locally grown Cinchona. One hesitates to mention Sandalwood when dealing with minor forest products but, thanks to careful organisation and propaganda, the retail sale of Sandalwood all over India is on the increase during the last few years, and receipts from this source have reached the 2 lakh mark.

It has to be reminded that forest utilisation is but a part—although admittedly a very important part—of forestry. The afforestation and conservation of our resources are a vital part of the programme. The exploitation of forests,—especially round about Bhadravati, is followed up by methodical regeneration operations. This is proceeding in accordance with an elaborately drawn up plan and careful measurements and surveys show that the regeneration is in close conformity with the calculations on which current practices are based. It is also interesting to record that the rate at which teak plantations are being raised in Mysore offsets three to four times the mature teak crop that is being harvested. During the last decade teak plantations are being formed at the average rate of 500 acres per year and in the peak year—1934—over 1,100 acres were stocked with Teak. From figures gathered, it is revealed that the satisfactory compensatory regeneration of teak in Mysore has reached a level which compares favourably with any other province in India. The total area of teak plantations in the State which was 5·62 thousand acres in 1926 has now been increased to more than double this figure, being 12·64 thousand acres in 1939. This policy of steady afforestation on conservative lines has received a further fillip by the growing demand for domestic fuel in the urban areas. In this connection, the technique of raising Casuarina is almost perfected, and a new method for other fuel crops by "patch sowing" is meeting with considerable success. An outstanding example of afforestation work during the period under review is provided by the Hulikere plantations in the Irwin Canal area. In the development of Mysore forests, therefore, posterity is not being mortgaged. On the other hand, there have been perceptible additions to the capital.

Mention has already been made of the important accessories which forests provide to an agricultural community. These are chiefly grazing, small timber, fuel, manure and minor forest produce. With respect to every one of these, regulations have been, within the last fourteen years, liberalised in

favour of the ryot. And in times of distress like drought, epidemics, fire, etc., the forests resources are freely thrown open to the ryot. Apart from this, the forests are making their own contribution to the rural reconstruction schemes in the State by the raising and supply of suitable seedlings for avenues, village groves and gardens. It is not easy exactly to assess the monetary equivalent of these concessions and services. To take but one example, in addition to grazing facilities enjoyed by the ryot on payment of the usual (but nominal) rates, nearly 400,000 heads of cattle were allowed in 1938-39 to resort to the State forests for grazing either free or at concession rates.

The necessary prelude to the methodical exploitation of any forest is its survey and preparation of working plan. Steady progress has been kept up. Thus while in the year 1925-26, 1,106 sq. miles had been provided with sanctioned working plans, the area had increased by 786 sq. miles to 1,892 sq. miles in 1939. Besides, some 500 sq. miles of forest have been brought under "provisional plans". The Department also maintains nearly 400 miles of forest roads and paths. The feasibility of bettering forest transport by the provision of treated timber bridges has been taken up, and it is hoped to have a few of them fabricated soon; they would, in addition, have a demonstration value.

In the midst of so crowded a programme, measures for the conservation of Mysore fauna have not been overlooked. A special authoritative committee was appointed in 1937 and based upon their comprehensive report, Government have recently passed orders designed to give the necessary protection to the cultivator from the ravages of wild animals, the desirable amenities to the *bona fide* sportsman, and at the same time sternly to put down poaching and other illicit practices. The improvement and extension of Game sanctuaries have been taken up. The Karapur and Bandipur Kheddah and Game camps are world-famous; the strict protection afforded in the sanctuary of the Chamarajanagar forests is already yielding results, and tigers, which had become almost extinct in this region, are moving towards their old haunts. In collaboration with the Bombay Natural History Society, a survey of the birds in the State has been conducted, and this year a bird sanctuary was formed on three islands in the Cauvery River near Seringapatam. Measures have also been planned to make a survey of fish, and its preservation to provide a regular supply for consumption.

Forestry education has always presented a problem in India. During the period under review, an innovation was made in the training of recruits to the Mysore Forest Service. A number of selected Science graduates, after preliminary training in the Mysore forests, were sent abroad to reputed centres of Forest research, so that in the Service to-day are to be found men trained in Indian, English, Continental and American schools, lending a catholicity of outlook to the Service as a whole. Just this year, a Forest School has been opened for the training of men to the executive cadres.

In establishing the Forest Research Laboratory in 1938, Mysore has taken an important step, being the first province or State in India to have set up such a laboratory. The famous Forest Research Institute, Dehra Dun, maintained by the Central Government, was till now the only Institution in India devoted to Forestry research. Although the beginning in Mysore is small, it is pregnant with possibilities. And it is pleasing to record that the entire investment for the Forest Research Laboratory was provided from out of the profits of the Wood Preservation Plant. The *raison d'être* for the Research Laboratory was summed up as follows by the Dewan in his address to the Mysore Assembly in September 1938:—"Mysore is fortunate in its forests which, apart from their great value to the ryot and their importance to rural economy, have contributed large sums to the State Exchequer. A fuller and more economic utilisation of our forest resources has engaged the attention of the Government, and, as I said in my speech at the last session of this Assembly, they have sanctioned the proposal of the Chief Conservator of Forests to establish a Forest Research and Experimental Station at Bangalore. The Laboratories of the Institute, though small, are equipped on the most modern lines and provision has been made for a nursery and other adjuncts of an up-to-date forest research centre. . . . Our very large resources in soft woods have remained practically untapped, mainly on account of the lack of adequate knowledge about their properties.

Forest soils, the suitability of different species to each type of soil and soil erosion are problems which have not so far received the attention they deserve. The problem presented by the Spike disease of Sandal still remains to be solved. The better utilisation of even the minor forest products like tupra leaves, charcoal, insecticidal plants, tanning barks, etc., all mean more revenue to the Department. These, then, are some of the more important problems which will be tackled by the Institute." Within the two years of its existence, the Laboratory has done a considerable amount of the spade-work and has already paved the way for the utilisation of some practically unknown soft timber and successfully to introduce a couple of exotics of economic value.

So much for the retrospect of the last fourteen years—years full of plans and efforts and achievement. We may briefly indicate the developments in the immediate future. There is likely to be larger increases in the forest areas. After all Mysore has barely 15 per cent. of her total area under forests. Even the highly industrialised countries in Europe and Japan, have much larger proportions of their total areas afforested. And when the public realises the full significance to their well-being and even to their very existence, it is to be hoped it would co-operate wholeheartedly in extension and conservation of the forests. In the realm of utilisation, junglewoods are slowly but inexorably coming to their ow challenging the supremacy of the conve tional timbers. One can already perceive bias in favour of raising non-teak tim crops on a short-term rotation, the harve ed timber forming a raw material chemical processing industries instead forming mere structural construction; handles are on the way; plywood and la nated wood just round the corner. The of charcoal as motive power for transp has already been tried in the State and the absence of indigenous coal and pe supplies, it is a safe prophecy that the of forests in the State economy would even more pronounced. It might also p that Minor Forest Products are after all so minor at all. Lastly, let it be rememl ed that forests are a crop, therefore newable and therefore inexhaustible. T financial returns from forests thus repre an important item of non-tax revenue wh total capitalised value is of very great portance to the State.

The experience of these fourteen ye and the plans chalked out for the fu entitle one, therefore, not to complace but to quiet optimism. In the meanw there is the satisfaction of having gr two blades of grass where one grew be and of having made the one blade tha harvested go much further in use tha used to.

ABDUL JABBA

MINERAL DEVELOPMENT IN MYSORE

MYSORE has been contributing annually, in recent years, some 12 to 15 per cent. of the total value of mineral output in India, providing employment for more than 35,000 persons in several mining and mineral industries. The prominent position which the State now occupies in its mineral production is due to the great progress which it has made in mineral prospecting and mining operations during the period of the long regime of the late Maharaja of Mysore.

Starting work soon after its inception at the end of 1894, the Geological Department discovered, within a few years, several deposits of economic minerals and numerous old workings for gold during the course of the survey. There arose at once a rush for the exploitation of the minerals in the State, and till 1915, the prospecting and mining of these were mainly confined to private enterprise. The Department being actively engaged in conducting the systematic geological survey, was functioning, more or less, as an administrative and advisory organisation, in matters of mining and prospecting,—issuing licenses and leases and enforcing its prescribed rules and regulations in the conduct of mining operations. During this period, several of the old workings for gold were opened out by deep underground prospecting, but none of the licensees succeeded in establishing any paying mines. Some of the minerals such as the chrome and manganese ores, magnesite, mica, asbestos, etc., which could be sold readily—without any further treatment—were mined on a fairly large scale by shallow open quarrying and the minerals were being won solely for export purposes. Under these conditions, there arose a danger of the richest and most easily accessible of such mineral deposits getting rapidly depleted leaving the poorer ones as unprofitable and useless.

By 1915, the preliminary geological survey of the State was completed, and it was considered desirable that the Department should thereafter bestow greater attention on detailed mineral surveys and large-scale prospecting and development of mineral deposits of economic value. At this time, the scheme for setting up an iron smelting industry in the State being under consideration of Government, the Department started its large-scale prospecting operations on the iron ore deposits near Kemmangundi, in the Bababudan hills, to prove the extent and grade of ores for smelting purposes. Extensive prospecting operations were also carried out on some of the limestone deposits to locate some suitable flux. As a result of these investigations, the deposits then located, tested and developed were taken up for open cast mining, on a large scale, by the Mysore Iron and Steel Works, which started the smelting operations in 1922.

In addition, the Department started detailed investigations in several parts of the State to study the available resources of various other minerals—both metallic and non-metallic. Private enterprise in mining and prospecting was, as before, confined mostly to minerals which could be readily exported, although some small quantities of China clay, soap-stone and a few other minerals were mined to a small extent for local consumption.

In 1926, the Department initiated intensive mineral development programmes undertaking special investigations for devising ways and means to utilise the available minerals for setting up suitable local industries, and also by taking up large scale mining operations, under direct Government control, in respect of a few of the mineral deposits. A chemical laboratory was fitted up for the Department, as an adjunct, for conducting assays and analyses of rocks and minerals and other investigations.

As a result of investigations on some of the non-metallic minerals carried out thereafter, the Government established a Porcelain Factory at Bangalore, a Cement Factory at Bhadravati, and a Paint Factory at Mysore; and with the aid of Government, a Stoneware Factory and a Glass and Enamel Factory have also been started, near Bangalore, by private enterprise.

Of the mining operations undertaken by the Department, a special mention may be made of the mining of the deposits of high grade chromite at Byrapur, in the Hassan District. In the course of about 12 years, 1926–38, by systematic open-cast mining to a depth of more than 100 feet below surface, over 50,000 tons of ore were raised; and a

sum of nearly 12 lakhs of rupees was realised by the sale of this ore. With a view to conserve the remaining portions of this deposit of high grade ore for the future needs of the State, the mining of this ore has been recently discontinued. The Departmental mining in respect of other minerals, *viz.*, graphite, asbestos, kaolin, quartz and felspar, which are required in the several industrial concerns of Government, has been steadily growing.

In addition to the mining of the above-mentioned minerals extensive prospecting operations for ores of copper, lead and antimony, and for non-metallic minerals like corundum, kyanite, bauxite, limestone, etc., are being carried out in several parts of the State. As most of these works had to be done by ordinary trenching and shafting, the progress was rather slow and it was also difficult and expensive to test any of the deposits beyond a depth of 30 or 40 feet.

An advancement in the methods of prospecting has been made during the last three years when a Calyx Core Drill was added to the equipment of the Department. The testing of the mineral deposits to greater depths by drilling and a more intensive prospecting by careful classification and demarcation of the different grades of the deposits on the results of the systematic sampling and analyses of cores have since then been undertaken. The high calcium limestone deposits at Bhadigund, (now used by the Cement Factory at Bhadravati) and the chromite deposits of Byrapur have been already prospected by such drilling; the results indicating a reserve of over 2 million tons of high calcium limestone and over 40,000 tons of high grade chrome in the respective deposits.

A further advancement in mineral exploration and prospecting has been made recently by starting geophysical survey. A programme employing some of the electrical methods has been chalked out. During the last two years, surveys for the location of deposits of sulphide ores have been carried out by the spontaneous Polarization, the D.C. Equipotential line and the Resistivity methods. At a few localities the determination of the underground water table, by the Earth Resistivity methods has also been carried out in addition.

In addition to mere location and testing the extent of the mineral deposits, or mining those which are required for certain existing industries, it is necessary to ascertain to what specific purpose or purposes each of the larger mineral deposits would be best suited and how best the inferior material could be utilised as it is, or by processes of special treatment and concentration. To conduct these experiments the Department is now equipped with a small laboratory where investigations on ore crushing and concentration could be undertaken. This laboratory, which was fitted up in 1939, is equipped with a crusher, pulveriser, jig, a set of concentration tables, flotation unit and also an electric furnace. Some investigations on the concentration of graphite, kyanite, sillimanite and other minerals from low grade ores; the preparation of asbestos cement sheets from Mysore cement and asbestos; the calcination of soapstone for making metal polish and a few other investigations have recently been carried out in this laboratory.

There remains much to be done yet to make the best use of the available mineral deposits of the State. It is not possible to give here a detailed future programme of work of the Department, but the following main items will give some idea in which the Department will be engaged in investigations of mineral development and other branches of applied geology in the immediate future:—

(1) Deep underground prospecting on some of the auriferous lodes in the Honnali taluk.

(2) Geophysical survey of the sulphide zones and graphitic regions.

(3) Investigations on ore concentration,—specially graphite, refractories and corundum.

(4) Investigations on the suitability of some of the Mysore minerals for manufacture of chemical products.

(5) Investigation and classification of mineral deposits for specific purposes.

(6) Hydrographic and soil surveys.

B. RAMA RAO.

A BRIEF NOTE ON THE ACTIVITIES OF THE DEPARTMENT OF HORTICULTURE

AMONG the factors that contribute to the health and happiness of the people of any country are abundant supply of 'protective' food including fruits and vegetables, pleasant surroundings and lung spaces in the form of parks and gardens for fresh air and light, and sports fields for exercise. For providing these, the Government of Mysore, through the Horticultural Department, have spared no pains in taking full advantage of the natural facilities existing in the State.

The activities of the Government Gardens Department which were confined only to a few public gardens and parks in the cities of Mysore and Bangalore have within the past quarter of a century spread far and wide in the State. The intensive efforts of the Department have resulted in the formation of a number of gardens, both public and private, in all parts of the State. Municipalities, District Boards, Village Panchayats and other local bodies have assisted in the planting of avenues and topes, and the formation of parks, squares, circles, etc., in various places.

The Government Botanic Gardens in Lalbagh and the Cubbon Park in Bangalore, the Curzon Park and Gordon Park in Mysore, and Dar-i-Dowlat Bagh at Seringapatam were the old well-known gardens and parks; we have now the famous Brindavana Gardens at Krishnarajasagara, besides many other parks and gardens which are of outstanding beauty.

The Horticultural Farm at Bangalore is the main centre of work on vegetable cultivation. Many new kinds and varieties of vegetables, grasses, etc., have been imported, acclimatised and distributed to the public in and outside the State.

As a result of a scheme for research on fruit cultivation put up by the writer before the Imperial Council of Agricultural Research at Simla in 1934, a Fruit Research Station has been established at a cost of Rs. 1,54,320 at Hessarghatta near Bangalore. The cost of land, buildings, water supply, etc., is met by the Government of Mysore, while the cost of maintenance—Rs. 46,200 for five years—is provided by the Imperial Council of Agricultural Research, Government of India. The opening of a Central Fruit Nursery at Lalbagh has been of great help in distribution of fruit plants. The Government have given much help in the shape of land, water supply, etc., for the revival of fig cultivation in Ganjam village which was once famous for figs. The grant of fruit cultivation loans is another step taken by the Government of Mysore for the encouragement of fruit cultivation. District Horticultural Inspectors are appointed to help garden owners in the cultivation of fruits and vegetables.

The Mysore Horticultural Society which is aided by Government does a great deal in creating interest in horticulture in the minds of the public. The result of the activities of the Society could be seen in the numerous beautiful gardens around houses in Bangalore and in Mysore. Two shows are held annually in which a great display of flowers, fruits and vegetables is made.

The Nandi Hill Station which is under the management of the Horticultural Department is popular as a health resort in summer. The Government have a motor road to the top of the hill constructed recently; this is a great convenience to the visitors to the Hill.

The numerous beautiful buildings, roads, boulevards, avenues, squares and circles, gardens and parks and illuminations not only in Mysore and Bangalore cities but in many towns and villages of the State are standing monuments of the keen interest and active support given during the past quarter of a century by His late Highness Sri Krishnaraja Wadiyar Bahadur and Amin-ul-Mulk Sir Mirza M. Ismail as Huzur Secretary and Private Secretary to His late Highness and later as Dewan of Mysore. It is certain that this field of work will receive the same support and encouragement at the hands of our present Ruler, His Highness the Maharaja Sri Jaya Chamaraja Wadiyar Bahadur who evinces keen interest in the activities of the Department.

H. C. JAVARAYA.

HYDRO-ELECTRIC DEVELOPMENT IN MYSORE STATE DURING THE PAST FOURTEEN YEARS

HYDRO-ELECTRIC expansion in the last fourteen years has been of considerable help in revolutionising the complete outlook of all the people of Mysore State. The forward policy of the Government, with their constant endeavour to develop the resources of the State in all ways, has necessitated the expansion of the natural power resources of the State as represented by its rivers. Nature has been reasonably liberal in her gifts of hydro-power under conditions making it easy for production of electric energy. The industrial development, seen in the erection of large factories producing various commodities in the different places in the State, has been made possible by the increase in power, made available for their development, and conversely the hydro-electric development has followed the demand for power for the various activities in the State. It can definitely be stated that the great advancement in the prosperity of the State has been largely due to its natural power resources and their ordered and progressive development under the direction of the Government. Electric power is no longer associated with lights only in the minds of the citizens, who realise that they enjoy its benefits directly or indirectly in all their daily activities.

The hydro-electric development of the State was one of the earliest in the East and started in 1902 with a power supply of about 5,000 H.P. to the Kolar Gold Fields, and has steadily progressed to about 75,000 H.P. with the completion of the Shimsha New Project in 1940. The Jog Falls Scheme is under active contemplation, and will produce an additional power supply of 32,000 H.P. in the first stage with an ultimate capacity of 96,000 H.P. in the final stage. This programme of expansion has been worked up by the Department and approved by the Hydro-electric Committee in order to meet the anticipated and prospective demands for power that will occur during the next 10 years.

In the year 1926 the Sivasamudram Plant had a capacity of 41,000 H.P. and was supplying the cities of Bangalore, Mysore and Kolar Gold Fields to the number of consuming installations as per statement given below.

	1925–26	1939–40
Load	23,200 K.W. or 30,900 H.P.	46,900 K.W. or 62,500 H.P.
Units generated	153,214,000	278,339,051
House lighting	9,422	41,223
Street lights	5,680	17,991
Power installations	318	5,241
Places electrified	3	Towns 200
Transmission lines	188	Miles 625

In 1940 the combined capacity of both Sivasamudram and Shimsha Stations is 75,000 H.P. The maximum demand has already reached 65,300 H.P. and the total capacity of the Stations will be in demand and service in the near future. This rapid progress in the State has been always kept in view by the Department, and the Jog Falls Project will come into service, when the demands for extra power make it necessary.

The most salient features in the development during the last fourteen years are the completion of the Ninth Installation works at Sivasamudram and the Shimsha Project, the construction of 440 miles of transmission lines and the electrification of just 200 cities, towns and villages throughout the entire nine districts of the State.

The Ninth Installation at Sivasamudram consisted in the erection of an 8,000 H.P. generating set in place of two old 2,000 H.P. sets, the realigning of the 2,200 volt cables from the generators to the low tension bus, and the construction of the Balancing Reservoir with automatic gates. The construction of the balancing reservoir was taken up to economise the use of water for power development. The construction of the Krishnaraja Sagar Dam as a hydro-electric and irrigation project imposed a limit on the issue of water for power production and it became imperative to economise water as power demands increased. The main idea underlying this balancing reservoir is to draw water from the combined rivers Cauvery and Kabbini, adequate to generate the average load demand, or in other words to store water at light load times and issue it to the turbines at heavy load times. Before its construction it was necessary to maintain

always a steady flow in Sivasamudram Power Canals capable of generating the maximum load demand on the Station, as there was no reservoir near the forebay from which water could be drawn when the load was above average, or in which water could be stored when the demand was below average. A reservoir of this nature should be located as near as possible to the forebay in order that extra water may be immediately available when required. The balancing reservoir is at a distance of about ¼ mile from the forebay and has an absorption and issue capacity of 26 million cubic feet of water. Issues from the reservoir are controlled by two automatic gates, operated electrically by means of floats in the forebay, so set and adjusted that the gates are raised or lowered as and when required to maintain a constant level in the forebay irrespective of the load, and the water demand by the turbines. The scheme has been entirely successful, and there is practically no spillage waste over the weir in the forebay. The actual savings of water during the hot weather, when storage water from Krishnaraja Sagar is required, is about 2,500 million cubit feet per annum.

The Shimsha development was sanctioned in 1937 and completed in June 1940 as per schedule and has added 23,000 H.P. to 46,000 H.P. at Sivasamudram to meet the developing demand for power. The maximum load demand on the Stations has been 65,300 H.P. and is rapidly increasing as further blocks of power will be taken up by several large power installations and extensions of power supply centres.

The Shimsha Project will be mostly a waste water project when completed in all respects after the dam across Shimsha River near Hagellalli is constructed to impound the waste and seepage waters from the lands irrigated by the Irwin Canals and the river discharges during the monsoon seasons. At present the Shimsha turbines are supplied with water drawn from the balancing reservoir at Sivasamudram. The gross head available at Shimsha is 636 feet in comparison with 420 feet at Sivasamudram and will thus develop one and a half times the power for the same flow of water. Two units of a total capacity of 23,000 H.P. are installed with provision for a third unit.

The following chart and statements give the load demand for the years noted based upon loads actually in view and the regular normal increase, the extent of the growth of electrification schemes and consumers, and the revenue realised.

The rivers Cauvery, Shimsha and Sharavathi are materially adding to the prosperity and happiness of the State in all respects, and the solicitude of His Highness the Maharaja and his Government for the welfare of each and every one of the subjects of Mysore in providing the amenities of life and the improvement of their economic condition finds no limit in the development of all the resources of the State according to well-developed programmes which require an assured and adequate power supply. The history of the hydro-electric development represents the corresponding increase in the various activities of the Mysore State contributing directly to the increase of wealth and happiness of the people.

S. G. FORBES.

INDIAN INSTITUTE OF SCIENCE

"THE late Mr. J. N. Tata desired to build and endow an institution which would provide Indian students with such facilities for work and training as would enable them to compete on equal terms with other countries as a producer of new knowledge and to aid Indian students to serve India in science and technology." As envisaged in this quotation the object of the Institute has been to train Indian students in methods of research in both Pure and Applied Science.

The activities of the various Departments of the Institute are briefly enumerated as follows:—

ORGANIC CHEMISTRY

A large amount of fundamental work in Organic Chemistry has been successfully carried out in this Department. Some of the more outstanding results relate to the Walden Inversion, Optical activity, Fatty acids, Synthesis of bicyclic terpenes, Heterocyclic chemistry, Asymmetric synthesis, etc.

In this Department there is a preparation section in which costly research chemicals required by the Department itself and others outside are prepared. The nucleus of what may be developed as an industrial concern for manufacturing fine chemicals has come into being. A number of natural products have been studied and the composition of several essential oils together with their methods of extraction have been successfully investigated. In addition a number of Indian medicinal plants have been examined with a view to making a complete analysis of their constituents.

GENERAL CHEMISTRY

Early studies included the cathode fall and spectra of rare gases and were followed by very accurate and painstaking investigation involving new technique and manipulative skill, on the atomic weights, compressibilities, refractive index and dielectric constant of rare gases of the atmosphere. The work of revision of atomic weights was extended to antimony and tantalum. The measurement of dielectric constants, refractive index and compressibilities of several other gases and vapours and the study of the influence of solvents on the dipole moment have formed subjects of more recent investigations.

A large number of early researches were directed to study the kinetics of reactions in solutions, such as esterification, hydrolysis, alcoholysis and acidolysis. Subsequent papers deal with the heterogeneous reactions such as oxidation reduction and dehydration on the surface of metals, oxides and salts, and the application of thermodynamics to the equilibria involved in these reactions.

Photochemical studies include oxidation of toluene and benzaldehyde and quantum efficiency of cis-trans conversion of cinnamic acids. Under this heading mention should be made of the valuable contribution on the nature of reactions in electrodeless discharge.

Study of optical properties of organic compounds such as, Raman spectra of isomeric compounds, absorption spectra, and rotary dispersion of isomeric terpenes and the relation between iodine value and refractive index, formed important part of more recent studies.

Colloid Chemistry. The study of petrol-water emulsions, detergent action of soaps, decolorising action of Fuller's earth adsorption and heats of adsorption by active carbon and silica gel formed some of the more important studies.

The physical properties of pure fatty acids, their glycerides and their mixtures and the phenomena of dimorphism, a mono- and tri-glycerides have also been studied.

Extensive investigations of the reactions of chromates and sulphates at high temperature have been made and have proved to be of considerable technical importance.

Manufacture of whitelead, thiosulphates and chromates from Indian chromite, refining of common salt, saltpetre and magnesium chloride, contact process of sulphuric acid and activation of carbon and Fuller's earth formed important part of industrial activities.

A large number of minerals have been analysed and in some cases new methods of analysis devised.

BIOCHEMISTRY DEPARTMENT

I. CONTRIBUTION TO THE DEVELOPMENT OF TECHNICAL MYCOLOGY IN INDIA

(*a*) *Power alcohol.* Experiments on the production of power alcohol from rice straw

and other cellulosic materials were successfully carried out in the Department and one of the workers in this line was employed by the Burma Oil Co., in connection with a scheme for the production of power alcohol from paddy straw.

(b) *Power gas*.—A process for the production of power gas from waste vegetation by its fermentation in septic tanks was developed.

(c) *Vinegar*.—At the request of the Government of Hyderabad a process for the manufacture of vinegar from alcohol was evolved which was subsequently taken up by Messrs. Cross and Blackwell Co.

(d) *Acids*.—Experiments on the production of lactic, gluconic and citric acids are now in progress.

II. Contributions to the Indian Lac Industry

The Department has pioneered researches on the entomological, sylvicultural and industrial aspects of the lac industry. The Department has been responsible for training a number of chemists and entomologists for this industry and it is a matter of pride to the Department that most of the members on the Chemical Staff of the Indian Lac Research Institute at Ranchi, are past students of the Institute.

One of the senior members of the staff of the Biochemistry Department has contributed largely to the development of the lac industry in Mysore and Madras. He was the consultant to the Government of Mysore on lac for a period of three years, during which period the cultivation of lac was put on scientific lines and a factory put up in Bangalore.

A considerable amount of work has been done on the industrial use of lac, one outstanding result of this has been the production of insulating varnish which has been used for the impregnation of transformers by the Government of Mysore.

Another line of work where the increased employment of lac has been ensured is the production of pigmented lacquers which has been developed. Promising results have been obtained in the direction of preparation of moulding powers from lac.

III. Utilisation of Trade Waste

Glue and Gelatin.—A process for the manufacture of glue from fleshings and gelatine from sinews was perfected in this Department.

Vegetable casein from nonedible seed cakes was prepared by a process which has been patented by the investigator. This casein has been found to be of considerable value in the preparation of distempers and water paints.

A large amount of work has been done in the Department on the utilisation of molasses which is a bye-product of the sugar industry. In addition to its employment in a raw material for the production of power alcohol its efficacy as a manure providing carbonaceous material for nitrogen fixation and thereby increasing the fertility of the soil has been thoroughly investigated in this Department.

Experiments on the employment of molasses for the solubilisation of the important constituents of the soil has also been investigated in a very detailed manner.

With a view to facilitate the transport of molasses, attempts have been made to solidify the products. This object has been successfully achieved by an admixture of quicklime and molasses which results in a powdery mass which can then be transported easily. This has been made the subject of a patent by the investigators. This product has been produced on a commercial scale and is being tried as a manure in the experimental plots in the sugarcane farm at Mandya.

IV. Contributions to Agricultural Industries

One of the more recent investigations on the utilisation of agricultural produce has been the production of malt from ragi. The ragi malt has been found to be superior to the one from barley in several respects. It has been found that it has a higher amount of assimilable calcium, higher amounts of vitamin B_1 and B_2 and traces of the essential elements like copper and manganese.

A large amount of work has been carried out in the preservation of fruit and fruit juices and also in the preparation of jams and jellies from various kinds of fruits. The Department has been the first to investigate the possibility of preserving mangoes, which has now been taken up by several canning factories in India.

V. Contribution to Economic Forestry

One of the major investigations which was carried out in the Department was the problem of the spike disease of sandal which was entrusted to the Institute by the Governments of Madras and Coorg. The investigation was carried on in an intensive manner for a period of 6½ years. Apart from the several fundamental advances which were made in forest pathology, it was found that the disease is carried by certain groups of insects. A considerable amount of light was thrown on the mode of natural dissemination of disease. This information has been of value in devising methods of effectively controlling the disease under sylvicultural conditions. It was found that the host plant of sandal plays a fundamental part in imparting immunity to sandal and this finding has been of great assistance in controlling disease in a more effective manner.

VI. Contributions to Foods and Nutrition

The biological value of several diets prevalent in different parts of the country has been examined. Investigation on the proteins of Indian foodstuffs have been carried out and in this respect the Department has acted as the pioneer. Several important investigations have been carried out on butter and ghee, especially with regard to their vitamin A contents. This work has been recognised by the Government of India and has been taken into consideration in organising grading centres for ghee in the country. One progressive firm in Bombay has taken up the manufacture of ghee under the advice and direction from one of the members of the staff.

The most important line of investigation in the field of foods is the research on the quality of rice which is being carried out with the help of a grant from the Imperial Council of Agricultural Research. Valuable results have been obtained.

The Imperial Council of Agricultural Research has financed a scheme for the preparation of organic manures by composting. The results of these researches have been widely applied in different parts of the country.

A considerable amount of work on fundamental Biochemistry has been carried out particularly in the field of enzymes, proteins and viruses and micro-chemistry. This work has been recognised by eminent authorities in the subjects.

ELECTRICAL TECHNOLOGY DEPARTMENT

The all-India character of the Institute is always kept in mind and the attempt is made to get the best students from all parts of India. Thus the students live in constant social contact with others from all parts of India.

Important additions were made to the Department in 1925 when the high tension laboratory was added providing testing facilities up to 350,000 volts, in 1927 when the radio laboratories were added, where also is housed the equipment which is recognised by the Government of India as the national standard of frequency. The south wing was added in 1932.

Alongside the teaching work there has always been a certain amount of research work. Investigations in different aspects of heavy and light current engineering have been conducted and the results have been published in technical journals in India and abroad.

The *Journal of the Electrical Engineering Society* has now become well established as an electrical engineering journal in India and is the only one of its kind in the country.

DEPARTMENT OF PHYSICS

In the Department of Physics work of fundamental importance is being carried out successfully in all departments of the subject, Magneto-optics, X-rays, Electron-diffraction, Ultrasonics, Colloid Physics and so on to mention only a few. The diversity of the subjects successfully tackled by the Department reflects the versatile character of the scientific interest of the distinguished physicist under whose inspiring guidance the members of the Physics Department are working. Its achievements are so varied and in various ways are so well known to the public that it is unnecessary to dwell on them in any detail.

Such in brief is a summary of what the Institute has done during the last 14 years. There is a great future for the Institute and it is the earnest hope of all interested in the welfare of our country that the Institute should occupy a predominant place of usefulness in the Industrial and Scientific life

of India. The Government of His Highness the Maharaja of Mysore have always taken the greatest interest in the affairs of the Institute, and their recent decision to restore the original grant of Rs. 50,000 a year testifies to their keen solicitude in its welfare.

FUTURE PROGRAMME OF WORK

The following new schemes of Industrial Research will be undertaken:—

Department of Chemistry:

(i) Manufacture of formaldehyde from methyl alcohol and of ethyl acetate and acetic acid from ethyl alcohol.

(ii) Manufacture of urea from ammonia and carbon dioxide for use as fertilisers.

(iii) Utilisation of phosphatic nodules of Trichinopoly as phosphate fertiliser.

(iv) Manufacture of sodium cyanide.

(v) Study of refractories and furnaces.

Laboratory preparation of the following types of drugs to be followed by semi-large scale operations:

(i) Antimalarials, Atebrin, Plasmoquine and allied substances;

(ii) Drugs to combat bacterial infections; sulphanilamide, dagenan, prontosil, etc.

(iii) Antisyphilitic drugs; Neosalvarsan, M-amino-*p*-hydroxy-phenylarsineo-oxide-hydrochloride, etc.

(iv) Intestinal antiseptics like Dimol, carbarsone, etc.

(v) Hypnotics, veronal, prominal, phanoderm and allied substances.

(vi) Analgesics and local anæsthetics, etc.

Department of Biochemistry:

(i) Technology of fermentation;—

The Department has been made responsible for a national collection of type cultures relating to technical mycology.

(ii) Technology of food products.

Department of Electrical Technology:

This laboratory will be developed as a centre of radio research.

J. C. Ghosh.

INDUSTRIAL LABOUR IN MYSORE

MYSORE, fast growing in its industries, is also growing in its industrial labour population, with its attendant problems of labour organisation, factory regulation, workmen's compensation, conciliation of industrial disputes, maternity benefit, housing, recreation, etc. Industries in Mysore can be classified under the following heads:—

1. Major industries like cotton, woollen and silk mills, railway and engineering workshops, iron and steel works, generation and distribution of electricity, sugar factory and brick and tile works.

2. Minor industries like sandal oil and soap factories, cotton gins, rice, flour and oil mills, tanneries, printing press, porcelain, glass and enamel works, fertiliser and chemical factories, etc., using power and employing 20 or more persons.

These two categories of industries come under the Factory Act. There were 250 such concerns in the State during the year 1937–38, out of which 48 were seasonal. The average daily number of operatives employed in all the factories was 25,526, of whom 19,409 were men, 4,581 were women, 449 adolescents, between the ages of 15 and 17, and 1,087 children between 12 and 15 years of age working half-time.

3. Mining industry, especially the production of gold in the Kolar Gold Fields employing on a daily average of 23,122 labourers. There is besides iron and chrome mining, which employ a much smaller number.

4. Plantations, principally of coffee and cardamom extending over a lakh of acres and employing on an average 29,000 of whom 10,000 are women. Not much attention is being paid towards the welfare of these labourers.

The problems connected with labour employed in the above industries vary according to the nature of the industry and therefore of the conditions of work. After the last European War and particularly with the organisation of the International Labour Office in Geneva, the discussions and conventions formulated from time to time, the responsibility for the protection and welfare of labour began to be considered as one of the prime functions of Government. Besides, industrial labour in all parts of the world began to get organised and to claim their right for united representation of their needs and grievances. And the growth of democracy, adult suffrage and the ballot box, gave to the masses their rightful position in shaping the destinies of their nation and of themselves.

In Mysore, where Government were keenly interested in the promotion of industrial prosperity, problems relating to labour welfare began to engage their attention. In 1920, the Director of Industries and Commerce wrote as follows in his report to Government. "As an industrial factor of considerable importance reference must also be made to the awakening among the labouring classes which has begun to manifest itself though perhaps in a crude form. The discontent which resulted in numerous strikes in the large industrial concerns of India has not left Mysore entirely unaffected .... While it may be premature in our conditions to have a separate Labour Commissioner or other organisations, I am of opinion that the Department of Industries and Commerce should study and keep in touch with labour conditions and labour problems of the State, and from time to time take such action as may be proper and suitable to maintain a good understanding between employers and workers." And every year there were strikes and disturbances, their causes being chiefly due to retrenchment and dismissal, refusal of bonus or gratuity, fines, demand for holidays and increased wages, victimisation for organising labour unions, etc. As the result of such constant friction between employers and employees, the Government of Mysore ordered in 1926 the appointment of the Director of Industries and Commerce as the ex-officio Labour Commissioner to deal with all questions relating to the welfare of labour. Earlier in 1925 Government amended the Factory Regulation, providing for the inspection of factories, regulating hours of work and minimum age of employment, and in 1927, they enacted the Workmen's Compensation Regulation for the payment of compensation for injuries caused to workmen. The Labour Commissioner was also appointed as the Chief Factory Inspector and

the Workmen's Compensation Officer. In addition the District Magistrates were also empowered to inspect factories and decide Workmen's Compensation cases.

With their constant solicitude for the welfare of the people and their modern and progressive ideals in administration, Government have further amended these Regulations and brought them into line with the Acts in British India, consequent on the various recommendations made by the Royal Commission on Labour, whose very informing report and liberal recommendations form the *Magna Charta* for Indian Labour. Curiously enough agitation has also been coming from the employers and capitalists in British Indian Provinces that labour conditions in the Indian States were very backward and thus worked as a handicap for their own industrial growth.

The Mysore Factories' Act of 1936 has fixed the maximum hours of work at 54 a week and 10 a day in non-seasonal factories, and 60 a week and 11 a day in seasonal ones, with compulsory weekly holidays and daily rest intervals. Children below 12 are prohibited from employment, and between 12 and 15 as half-timers, and no work at night for either children or women. Over-time work is to be given extra pay. Factories should submit periodical returns and be regularly inspected, and provisions have been made for maintaining them in clean, well-lighted, and sanitary condition, machinery well protected and also adequate shelters for the workers during the rest period and creche for the children of women employees. Prosecutions and penalties have been provided in the Act for contravention of the prescribed rules and regulations.

The Workmen's Compensation Act of 1936 gives relief to all factory, mine and railways workers, as also to those employed in motor transport, manufacture of explosives, construction of engineering works, and all other hazardous occupations. The amount of compensation to be paid is laid down, on a fairly liberal scale, according to the nature and incidence of the accident, and in the case of fatal accidents, the dependents will be given the benefit. The Motor Transport Act has prescribed the maximum hours of work for drivers and conductors and has provided for rest periods.

The Mysore Maternity Benefit Act was enacted in 1937, prescribing the grant of leave with pay 4 weeks before and 4 weeks after confinement, to all women employees in factories. The Act also protects the women from being dismissed during the period of benefit, and provision is made for conviction of the employer to a fine for contravention of the rules.

The Mysore Mines Act, passed in 1906, provides for regular inspection of the mines, proper safety for the employees and provision of ventilation, light and water. Though the Act does not fix any hours of work, the Kolar Gold Mining authorities have adopted an 8-hour shift.

With regard to plantation labour, there is no specific Act, but in 1933 the Government repealed the Workmen's Breach of Contract Act and the relevant sections of the Penal Code, thus abolishing forced labour and criminal penalties for breaches of contract.

Labourers throughout the world and in India, have won for themselves a position of security and proper treatment by their power of organisation and unified action. It has unfortunately been a case of continued conflict and wringing out a share in profits and privileges from the unwilling hands of employers and capitalists. It is only by a well-devised scheme of co-partnership that peace can be established in industrial relationship. Labour in Mysore has been no exception. They grew in class consciousness, and every strike or lock-out brought forth added organisation and leadership. In 1927, the then Labour Commissioner stated as follows:—

"In the disorganised condition of labour, it was difficult to formulate their grievances and to seek suitable remedies at the hands of the employers .... The growing consciousness of labour is well illustrated by the readiness with which associations of persons employed in certain trades are formed .... It is desirable that an enactment analogous to the British Indian Trade Union Act should soon be passed in the State. In the absence of such legislation it is difficult for labour to organise itself on proper lines and their leaders suffer under serious disadvantages. The frequency of labour disputes and the absence of suitable machinery to avert or terminate them satisfactorily point to the need of legislation facilitating the institution of conciliation or arbitration boards." But uptill now in spite of repeated representations, neither the Trade Union Act nor the

Industrial Disputes Act has been enacted in the State. Government have, however, constituted in 1931 the Conciliation Board, which has recently been enlarged as the Labour Welfare Board, to deal with a wide range of questions affecting industrial labour. The Labour Commissioner is the ex-officio Chairman of the Board and amongst the members are representatives of the employers, the employees and the public. The Board meets periodically to review the relationship between labour and capital, propose methods of settling differences, recommend to Government to take suitable action, and generally consider all questions affecting labour and refer them to the employers. Above all, under the administration of our present Dewan, Sir Mirza M. Ismail, who takes a personal interest in the welfare of labourers, they have been able to secure a great many advantages in the way of better housing, increased wages, and satisfactory settlement of their needs and grievances. He has also been a great exponent of labour welfare settlements, where the educated youths of the country will learn to mix freely with labourers and render service to them. At his instance the Mysore University Social Service Settlement has been formed in Bangalore on a permanent basis.

The major employers of labour in the State,—and it must be said to the great credit of the European employers in particular the managements of the Kolar Gold Mines and the Binny Mills,—have established good and sanitary housing colonies for their workmen, medical relief and maternity hospitals, day and night schools, recreation and games, co-operative societies and cheap credit banks, etc. Government are also spending large sums of money to provide all these amenities to the labourers in their concerns, the Bhadravati Iron and Steel Works, the Mandya Sugar Factory and the Krishnarajendra Mills. The Managers of the Maharaja and Minerva Mills in Bangalore have built quarters for some of their workmen and are proposing to build more, and they also run very useful co-operative stores and banks. In addition they are contributing very liberally to a private organisation—the Seva Ashram Home of Service for Labourers—to carry on educational work. The Bangalore City Municipality have spent over a lakh of rupees in laying out a Model Labour Colony with sanitary and lighting conveniences and constructing 250 tiled houses, which are rented out to labourers for two rupees a month. Other Municipalities in the State are also planning extensions for industrial establishments and labour housing.

Other important pieces of legislation for the protection of labourers have been the amendments of the Civil Procedure Code exempting the salaries of labourers below Rs. 50 per month from attachment towards debt, and protecting honest debtors from detention in jail. The recent Mysore Money-lenders Act is a very comprehensive regulation for the registration of money-lenders and prescribes the proper maintenance of accounts, grant of receipts, the maximum interest chargeable, etc., all of which are very helpful to protect the unwary and needy labourers from becoming victims to the usurious and unscrupulous money-lenders and pawnbrokers. It is indeed no loss but a great boon, if credit is made unavailable to the monthly wage-earning labourers. Government have also ordered the closure of drink shops on pay-days in the industrial towns of Bhadravati and Mysore, and are contemplating similar steps in Kolar Gold Fields, Bangalore City and other places.

In the political field, Labour has at present two seats in the Representative Assembly and one in the Legislative Council, all of them being filled by nominations by Government. But in the forthcoming New Reforms, Labour has been given three seats in the Assembly and two in the Legislative Council, to be elected by the enfranchised labourers from amongst themselves. Thus in future labour in Mysore can well look to their own leaders to secure for them their just needs.

T. Ramachandra.

INDUSTRIAL PROGRESS IN MYSORE DURING THE PAST FIFTEEN YEARS

THE year 1926 can be rightly said to mark the beginning of Industrial Renaissance in Mysore. In reviewing the development of the State during the past decade '*The Great Britain and the East*' writes as follows:—

"While agriculture has received its rightful share of attention in the economy of the State, its industrialisation has been pressed forward with vigour. ... It is indeed in this latter direction that progress has been most marked. Whether in basic, cottage, small- or large-scale industries the advancement achieved in the last decade has been truly remarkable, and as stated above, has won for the State a position envied but not eclipsed elsewhere."

The Government of Mysore have been following for over half a century and particularly since the year 1926, a policy of vigorous state effort towards progressive Industrialisation. They have assisted the promotion of industrial enterprise in the State in several ways, more important of which are the following:—

1. Establishing Industrial Concerns owned and controlled by Government in the larger interests of the State.

2. Pioneering of Industries with a view to handing them over ultimately to private enterprise.

3. Providing financial aid under the rules regulating the grant of loans for Industrial and Agricultural purposes, by giving *taccavi* loans and supplying plant and machinery on the hire-purchase system.

4. Encouraging private enterprise to start large-scale industries on a joint-stock basis by the grant of concessions on the following lines:—

(*i*) Subscribing to the share capital of the concerns.

(*ii*) Granting land, water and electric power free of charge or at concession rates.

(*iii*) Guaranteeing the purchase of the products of concerns to the extent of their requirements provided quality and price are satisfactory.

5. Opening of departmental show-rooms in important cities like Bombay, Madras, etc., to find a market for the products of Mysore Industries and to popularise them.

During the period under review, as many as 26 major industrial concerns were established in the State. Most of these Industries are what may be termed as 'Basic' or 'Key' Industries. The addition of a steel-making plant to the Bhadravati Iron and Steel Works, establishment of factories for the manufacture of paper, cement, porcelain insulators and other electrical materials, electrical transformers, workshop machinery and machine tools, lac products and paints, bakelite articles, sugar and power alcohol from molasses, stoneware pipes and potteries, electric lamps, sulphuric acid and other heavy and fine chemicals, fertilizers, flue cured tobacco, vegetable ghee, cured coffee, glass and enamel ware, electric storage batteries, spun silk yarn, pharmaceutical products and chrome-tanned leather. These are some of the important additions that have been made to the long list of industries that were already in existence.

There are now as many as 31 major industrial concerns (excluding the Hydro-Electric Works, textile mills, in Bangalore and the Gold Mining Companies in Kolar) with a total capital investment of about 510 lakhs of rupees and employing about 17,000 persons.

Under the Rules for the grant of loans for Industrial and Agricultural purposes, the Department has granted loans amounting to as much as Rs. 17½ lakhs to private enterprise for starting and developing industries. These have been supplemented by private capital to the extent of Rs. 25 lakhs. Technical assistance and advice is also rendered by this Department in the erection of a large number of Industrial Installations and so far 718 installations at an approximate value of Rs. 23 lakhs have been put up by this Department.

As a result of the liberal State Aid granted to Industries, particularly from the year 1926, in several directions as enumerated above, apart from the several kinds of industries employing less than 10 people there are now as many as 370 large Industrial

Concerns in the State, each employing on an average 10 or more persons per day. The average daily number of persons employed on all these concerns is as many as 66,000.

While encouraging the establishment and growth of large-scale and medium-sized industries, the Department is equally alive to the importance of Minor and Rural and Cottage Industries.

The Department of Industries has prepared a Three-Year Plan of Development of Rural and Cottage Industries involving an expenditure of nearly Rs. 1½ lakhs, which the Government of Mysore have been graciously pleased to sanction. The Programme of Development provides for the reviving of village industries which once existed in the State but which, owing to various causes had languished, and for the starting of new village industries in suitable centres. Under this scheme, already a number of village industries such as tanneries, tile works, paper making, envelope making, hardware and smithy, lacquerware, improved pottery making, coir making, hand spinning, hand-loom weaving, sericulture, etc., have been introduced in a number of centres in the State.

Sericulture is an important industry in the State practised on cottage industry basis, providing occupation to nearly one-eighth of the population. During the past fourteen years, Government have been pleased to spend as much as Rs. 27 lakhs to develop this industry as a result of which sericulturists in the State have been benefited greatly. The important place which the Sericultural Industry in Mysore occupies in the Indian Silk Industry, is due entirely to the large and liberal financial and technical assistance of Government who are keen about the development of this industry and are solicitous in the welfare of a large portion of the population depending upon it. Next in importance is the hand-loom weaving industry. There are as many as 30,000 looms in the State providing occupation to nearly 30,000 families. This industry is in the throes of distress owing to competition from organised industry on the one hand and want of knowledge of improved methods on the other. In order to revitalise this industry and place it on a sound basis the Department has been doing a great deal of work. The weaving demonstration staff of the Department has conducted demonstrations in a large number of weaving centres in improved methods of weaving. The Department has spent more than two lakhs of rupees on this account during the past eleven years and the value of improved appliances introduced amounts to more than Rs. 24,000.

The supply of cheap electric power has given an impetus to hand-loom weavers to instal power looms. There are, at present, about 800 power looms.

With a view to improving the condition of hand-loom weavers, the Department has opened yarn depots in a number of centres. These depots are purchasing yarn in bulk and are supplying the same at cost price, thus saving middleman's profit to the weavers. The depots are also furnishing weavers with improved and readily saleable designs.

As a result of these activities, the hand-loom weaving industry has been able to regain much of its lost ground and hold its own against competition and handicaps.

The programme for the future includes the intensive development of the hand-loom weaving industry, medium-sized, minor and cottage industries and marketing organisations among other activities of the Department.

The facts and figures furnished above are sufficient to indicate that the History of Mysore Industries during the past decade is a History of a systematic and continuous development, which is largely due to the 'enlightened guidance' of the Dewan, whose 'advice on the development of the resources of the State' and personal encouragement has done much towards fostering that 'Spirit of enthusiasm which is the basis of success'.

B. G. APPADURAI MUDALIAR.

THE PROGRESS MADE IN IRRIGATION, CIVIL WORKS AND COMMUNICATIONS

THERE has been a general improvement in the activities of the development departments of the State during the last fourteen years.

IRRIGATION

The grants for irrigation works, which stood at about 5 lakhs in the year 1926, has steadily increased during the past 14 years, to about Rs. 21 lakhs in 1939–40 and to Rs. 27 lakhs during the current year. The increased grants have facilitated the construction of several big irrigation works, protective as well as productive, in the several parts of the State with the result that irrigational facilities are extended all over the country. It has been the recognised policy of Government to mitigate the distress in arid tracts by constructing reservoirs and a special fund known as the Irrigation Development Fund has been created for this purpose. In order to ensure a steady progress on the restoration of tanks, whose capacities get impaired due to silting or other causes, a consolidated triennial programme has been prepared for being pursued systematically. Action is being taken to use the water in the tanks as economically as possible by the use of siphon spillways and modern designs of sluice shutters.

Among the major irrigation works taken up and completed during the past 14 years, may be mentioned (1) the Maralwadi tank in Kankanhalli Taluk, (2) the Thumbadi tank, Koratagere Taluk, (3) Kamasamudram tank, Bowringpet Taluk, (4) Nidasale tank, Kunigal Taluk, (5) Dalavoy tank, Chicknaikanhalli Taluk, and (6) the Marconahalli Reservoir, Kunigal Taluk. Several large irrigation works are also in progress, chief among which are (1) Alahalli tank, Kankanhalli Taluk, (2) Byramangala tank, Closepet Taluk, (3) Markandeya tank, Bowringpet Taluk, (4) Thippaganahalli tank, Goribidnur Taluk, and (6) Kanva tank, Chennapatna Taluk.

By far the biggest irrigation work of the period is the Irwin Canal from the Krishnaraj Sagar which was started in 1927. The main canal is 28 miles long up to the Hulikere tunnel and is bifurcated beyond the tunnel to two branches, the Maddur Branch and the Cauvery Branch. Works are nearly completed on the Maddur Branch and on the Shimsha and Kergod branches taking off from the Maddur Branch. The Cauvery Branch Works are in progress round about Hebbakvadi and Turuganur. Out of the extent of 1·2 lakhs of acres proposed for irrigation under the channel, an extent of nearly 55,000 acres are already under the plough. Irrigation of a tract so extensive as this has its own special problems which are being dealt with by the co-operation of the Irrigation, Agricultural, Revenue and the Health Departments. Elaborate surveys were made all over the irrigable area to determine the nature of the soil and to take suitable precautions in advance to prevent waterlogging and salinity. The system of irrigation known as the 'Block System' has been specially adopted with a view to prevent waterlogging and malaria in the irrigated tract. An agricultural farm is being run at Ganadalu near Mandya to educate the farmer and to advise him on the selection of crops. The main crops grown in the Irwin Canal tract are paddy, sugarcane and irrigated dry crops. In order to consume the sugarcane grown, a Sugar Factory has been started at Mandya through Government help. Further extension of irrigation in the Cauvery Branch is proceeding rapidly.

The extension of the hydro-electric works at Sivasamudram and Shimshapura has been possible owing to the availability of water from the Krishnaraj Sagar all round the year. The Krishnaraj Sagar Works are being worked as a combined irrigation and hydro-electric scheme with great success.

In order to keep pace with the growing demands for electric power in and outside the State owing to the industrialisation of the area, Government have just sanctioned a scheme for generating 48,000 H.P. at Jog and the works on the construction of the main storage dam at Hirebasgar are under progress.

CIVIL WORKS

The period from 1926 to date marks an era of continued progress on the construction of modern buildings in the State. A separate Architectural Section has been

constituted to furnish well-considered designs for the structures proposed for construction.

The construction of buildings for hospitals and wards all over the State is a special feature in the programme of building construction during the period. As a result of the personal contact of the Dewan with the leading public men of the various places, liberal donations have been paid by philanthropists for the construction of dispensaries and maternity homes without taxing the finances of the State heavily. Similar progress is also in evidence in the case of educational institutions. The buildings, parks and gardens brought into existence during the past 14 years have not only immensely benefited the people of the State but also increased the artistic beauty and improved the public health of the several towns and cities. Another memorable event of the period is the renovation of Belur and Halebid temples, the monuments of ancient Indian sculpture.

Communications

There has been a remarkable improvement in the maintenance of communications during the past 14 years. The improvement in the road surface is keeping pace with the growing needs of fast vehicular traffic. The District Boards and Village Panchayats are endeavouring to open inter-village roads in the interior parts of the State and to connect them with the thoroughfares. The arterial roads are painted or premixed with bitumen emulsion to suit modern high-speed traffic and to avoid the nuisance of dust. Cement concreting of roads is undertaken as an experimental measure in selected stretches of the more important roads. The portions of through routes running through the hearts of towns or busy villages are deviated outside the towns to avert accidents. The ghat roads are straightened and widened at curves at a heavy cost with the result that the journey over them which was once considered difficult and almost risky is now made easy and comfortable. A visitor to the State need no longer be perplexed on any cross road as different signs and name boards are put up on different types of roads in accordance with international standards. A separate road fund and Traffic Board are created to ensure proper attention to roads. Special attention is being paid to the planting of avenue trees.

Bridges

The big rivers and small streams cutting off communications are being steadily bridged. The work in this direction is going on hand-in-hand with the improvements of roads. Fording the rivers on main roads with inconvenience is fast becoming a thing of the past.

Several important bridges have been built over the main rivers partly with the help of the reserve funds with the Government of India. Among the major bridges built during the period may be mentioned the Gorur and Akkihebbal bridges over the Hemavati, Ramanathapur and T. Narasipur bridges over the Cauvery, Kapila bridge at T. Narasipur and the Shimsha bridge at Halagur. A number of small bridges have also been constructed in Kadur and Chitaldrug Districts from the Railway Cess Funds of the District Boards.

The Tunga bridge at Thirthahalli is under construction. A programme of bridges yet to be built as funds permit is being prepared from time to time.

Water Supply

By constructing a reservoir at Thippagondanahalli for supplying pure water for drinking purposes to the growing population of Bangalore City and Civil and Military Station, the administration of the period has offered a boon to the Municipalities and to the public.

Several water supply schemes have been executed in the moffusils.

Miscellaneous

Improvements in the drainage system of towns, the layout of extensions in towns and cities and of parks and public resorts are progressing steadily. Drinking water wells are being provided in increasing numbers in the rural parts.

An Aerodrome at Jakkur near Bangalore is in service and another at Mysore is being formed. Service from Madras to Hyderabad *via* Bangalore is also opened.

Opening a broadcasting Radio Station in the State is also under contemplation.

N. Sarabhoja.

THE MYSORE CONSTITUTION

AMONG the Indian States, Mysore occupies the foremost place on account of its size, population and revenue combined with its progressive and up-to-date administration. Modelled on British Indian lines during the days of British Commission which was in charge of the administration of the State for quite half a century from 1831, to 1881, it compares most favourably in point of efficiency with that of any province in British India. It has further had the advantage of being under the control of good and benevolent rulers who identified themselves with their subjects and whose only aim was the promotion of their happiness and prosperity. One of the first acts of His Highness the Maharaja Chamaraja Wadiyar Bahadur on his assuming the administration of the State in 1881 was the establishment of the Representative Assembly—an unique institution and the first of its kind anywhere in India, the object of which was to associate the people of the State with the administration by inviting their leading representatives to the Assembly and giving them an opportunity of getting acquainted with the measures and policies of Government and of giving expression to their views thereon as also to the wants and grievances of the people in all departments of administration. The members of the Assembly were in the beginning, nominated by Government; but in course of time, all the seats in the Assembly were thrown open to election and several other privileges were also given to its members from time to time. The next step towards the liberalisation of the administration was taken in 1907 by the establishment of the Legislative Council to associate the representatives of the people in the making of laws, which had till then been solely the function of the executive Government. Fifteen years later, with a view to satisfy the desire of the people of the State for an extension of the powers and privileges of both the Representative Assembly and Legislative Council, a mixed committee of officials and non-officials with Dr. Sir Brijendranath Seal, Vice-Chancellor of the Mysore University, was appointed in 1922 to go fully into the question and submit proposals; and on the receipt of the Report of the Committee, the Representative Assembly and the Legislative Council Acts of 1923 were passed according to which the strength of these bodies was increased and certain additional privileges were given to them—such as the power to make interpellations and move resolutions, to discuss the annual budgets and vote on demands for grants, etc. With the advance of time and with the far-reaching changes that were introduced in the British Indian Legislatures under the Government of India Act of 1935, there was a demand in the State also for a further measure of reforms and also from a section of the people for a form of Responsible Government. In response to this demand, the Government again constituted in 1938 a Committee of 26 persons—of whom all but 2 were non-officials, representing all interests and communities to go thoroughly into all questions relating to the constitution of the State; and on the recommendation of the Committee, His Highness the Maharaja sanctioned in November, 1939, several far-reaching reforms calculated to further liberalise the constitution and associate the people more largely with the Government in the administration of the State. These reforms are all embodied in the Government of Mysore Act promulgated by His Highness, in April, 1940 and the Rules issued thereunder. It was, at first, the intention of Government to introduce the reforms during the current year itself by having the elections for the new Representative Assembly and Legislative Council conducted in the month of August last, but in view of the representations made to Government for a postponement of the elections owing to the inconvenience to which the voters and candidates would be put if the elections were held during the monsoon season, the Government have decided to have them postponed to an early date next year so that the new constitution may be brought into effect by the next Birthday session of the Representative Assembly.

2. A brief account of the new Constitution as sanctioned by His Highness the Maharaja and expected to be soon brought into effect will now be given. Taking up first the Representative Assembly, the maximum strength of the Assembly which is 275 at present will be raised to 325 under the

new Constitution, mainly by increasing the number of seats reserved for Mahommedans from 18 to 30 and for depressed classes from 6 to 30 (five times the present number) and providing 11 seats for women against only 4 at present. Of these, excepting 12 seats which may be filled by nomination by Government all the others will be thrown open for election. The Assembly will have the right to be consulted on every measure of legislation proposed to be introduced either by Government or by any private member before it is taken to the Legislative Council, emergent situations being met by the passing of temporary ordinances which will not be in force for more than a year under any circumstances. Any bill, either Government or private, which is opposed by a majority of two-thirds in the Assembly will not be taken before the Legislative Council, except in rare cases wherein Government consider it necessary to proceed with any Bill of theirs in public interests or for ensuring safety and good Government. In such cases, the Government should issue a statement explaining their reasons for proceeding with the bill notwithstanding the opposition of the Assembly to it. The franchise for the Assembly will be extended by lowering the property and educational qualifications of the voters so as to double their number immediately and increase it still further in course of time. The members of the Assembly will continue to enjoy the same privileges as at present in the matter of interpellations, representations and resolutions but the restriction placed on the number of interpellations, etc., which can be tabled by any member will be removed. The members of the Assembly will be empowered to discuss the annual Budget but demands for grants will not be placed before them and subjected to their voting.

3. Coming next to the Legislative Council, its present strength which consists of 53 members of whom only 21 are elected and the remaining 32 are nominated by Government, will be raised to 68 consisting of 44 elected members and 24 nominated members. The elected members will thus hereafter be in a decisive majority of about two-thirds and can therefore effectively influence the decisions of the Council. The Council will have the power to discuss the Budget and vote on the demands for grants for all Departments of Government, excepting a very few excluded items such as Palace, Pensions, Sinking Fund, Interest on Loans, etc. The salary of every officer of Government including the Dewan will be subject to the vote of the Council. The Dewan is, however, empowered to restore a demand rejected by the Council if, in his opinion, its rejection would affect the carrying on of any Department or the due discharge of the Government's responsibility. The Legislative Council will, instead of being presided over by the Dewan as ex-officio President as at present, hereafter have the privilege of electing its own President from among its members except that for the first term of the new Council the President will be appointed by His Highness the Maharaja. There will also be an elected Deputy President, an office which is newly created.

4. The most important feature of the new reforms will be in respect of the appointment of the Ministers. Whereas at present there are only two ministers (designated as Executive Members of Council) appointed by His Highness from the service, there will be not less than four ministers under the new Constitution, of whom two *at least* will be appointed by His Highness from among the *elected* non-official members of either the Representative Assembly or the Legislature. All the ministers will be ex-officio members of the Legislative Council. They will not be removable by a vote of no-confidence by the Legislature but their actions and policies may be criticised and condemned by means of resolutions, cut motions on demands for their salaries, etc.; and it will be left to His Highness to take suitable action on such resolutions by the removal of the ministers or by ordering a change in their policies, etc., according to the circumstances of each case. There will be no distinction made between the official and non-official ministers in respect of their pay and status or the distribution of the several administrative portfolios among them. The Dewan who will be appointed by His Highness and hold office at his pleasure will preside over the Council of ministers. He will not be a member of the Legislative Council but can attend meetings of the Council and address it, if he wishes to do so at any time.

5. I have described above only the main features of the new Constitution and have, for want of space, left out the minor items. These important features may be briefly summarised as follows:—

(1) Though there will be two constitutional bodies—the Representative Assembly and Legislative Council, the legislature will not be bicameral as the functions of the two bodies will be different.

(2) The Legislative Council will have a preponderating majority of elected non-official members who will thus have an effective voice in its decisions. It will have an elected President and Deputy President, elected from among its own non-official members.

(3) The elected representatives of the people on the Representative Assembly and Legislative Council will be actively associated with and made to share the responsibility for the administration by the appointment of *at least* two of them (it may be more or even all in course of time) as ministers.

(4) There will be no system of diarchy with its division of reserve and transferred subjects. All the ministers—whether official or non-official—will have equal powers and status and equal chances of holding the portfolio of any department.

(5) Though the ministers will be non-removable by a vote of no-confidence by the Council, their actions and policies will be subject to criticism and condemnation by the Council which will have a large elected non-official majority. They will therefore be practically responsible to the Council, subject, however, to their control by and responsibility to His Highness the Maharaja.

It may be safely said that the new Constitution which may be expected to be brought to effect within the next few months is far in advance of that of any of the other Indian States and that it will practically inaugurate a form of "Responsible Government under the ægis of the Maharaja" for which the Congress party in the State has been agitating for some time.

K. R. SRINIVASIENGAR.

RAILWAY DEVELOPMENT IN THE STATE

GENERAL

THE length of Mysore State Railway is 748·19 miles made up of:

9·88 miles of Broad (5′–6″) Gauge, (Kolar Gold Fields Railway) worked by M. & S.M. Ry. Co.

599·91 miles of Metre (3′–3⅜″) Gauge.

102·20 miles of Narrow (2′–6″) Gauge, and

36·20 miles of Tramways (2′–0″ Gauge).

The capital outlay is Rs. 673·70 lakhs, including Rs. 33·23 lakhs, provided by the District Board of Mysore for Nanjangud-Chamarajanagar Railway (22 miles) and Kolar District Board and the Bangalore–Chikballapur Light Railway Co., for 2′–6″ Gauge Railway (93 miles).

Railway Construction in the State.—During the great famine of 1877–78, the construction of the Mysore–Bangalore section (86·01 miles) was taken up and the line was opened for traffic in 1881–82. Bangalore–Gubbi section (53·73 miles) was next opened for traffic in 1884. Both these lines were constructed by State Agency under the supervision of European engineers, and worked by the State Railway Department.

Further construction work was interrupted owing to financial pressure chiefly brought on by the Famine Debt of Rs. 80 lakhs. Then, on the advice of the Government of India, the State Railway (140 miles) was hypothecated to the late Southern Mahratta Railway Company, for a sterling loan of £1,200,000. This amount was utilised partly in liquidating the Famine Debt to the Government of India, and partly for the construction of the Gubbi-Harihar section, by the agency of the same Southern Mahratta Railway Company. Simultaneously the working of the entire State Railway was also entrusted to the Company under a contract entered into by the Secretary of State on behalf of the Mysore Government for a period of 45 years, *i.e.*, to terminate in 1932.

In 1891, 15·04 miles of railway were constructed from Mysore to Nanjangud out of State funds by the Southern Mahratta Railway Company and opened for traffic.

Between 1892 and 1899, the following lines were built by the State Railway Construction Department, and afterwards made over to the Southern Mahratta Railway Company for working, along with the completed Gubbi-Harihar section under different contracts.

		Miles
1.	Bangalore–Hindupur line, Metre Gauge (year of opening 1892–93)	51·19
2.	Kolar Gold Fields Railway, Broad Gauge (year of opening 1894)	9·88
3.	Birur–Shimoga Railway, Metre Gauge (year of opening 1899)	37·92
4.	Nanjangud to Nanjangud Town, Metre Gauge (year of opening 1899)	0·76

In 1907, the Southern Mahratta Railway Company ceased to exist as it transformed itself into a new Company—the present Madras and Southern Mahratta Railway Company. The working of the Mysore State Lines was also transferred to this Company by the Secretary of State, under another contract entered into by him on behalf of the Mysore Government terminable in 1937 or five years later than the previous contract.

This was at a time when there was no independent State Railway Department in Mysore to take over the working of the Railways.

In 1912, a new State Railway Department was organised and a vigorous programme of construction work started. By 1918, the following new lines were completed and worked directly by the State:—

	Miles
Metre Gauge (3′–3⅜″)	
Mysore–Arsikere Railway (completed 1918)	102·95
Narrow Gauge (2′–6″)	
Bowringpet–Chikballapur Railway, partly financed by the Kolar District Board and partly by Government (completed 1916)	63·57
Chikballapur–Bangalore City, partly financed by Bangalore–Chikballapur Light Railway Company and partly by the State (completed 1918) ..	38·63
Tramways (2′–0″)	
Tarikere–Narasimharajapura (completed 1917) ..	26·60
TOTAL ..	231·75

With the opening of these new lines, efforts were made to get back for direct working, the lines previously leased to the

Madras and Southern Mahratta Railway Company. By negotiations with the Company and the good offices of the Secretary of State for India, it was possible to resume, in October 1919, the working of the two branch lines, Birur-Shimoga and Mysore-Nanjangud, and the section between Mysore and Bangalore.

To 371·50 miles of Railway directly managed by the State on 1st October 1919, the following new lines were afterwards added:—

	Miles
Metre Gauge (3′–3⅜″)	
Chickjajur–Chitaldrug. (This was financed by the State and completed in 1921) ..	20·90
Then came the Nanjangud–Chamarajanagar Railway, financed by the Mysore District Board and built in 1926	22·29
Shimoga–Anandapuram. Completed in 1934	35·95
Anandapuram–Sagara. Completed in 1938	16·33
Tramways (2′–0″)	
Tadasa–Hebbe. Completed in 1921. (This was financed by the State)	9·60
TOTAL ..	105·07

Thus, the total open mileage of the State Railway system comes to 748·19 miles, on 30th June 1940, as per particulars with cost given below.

The construction of the line from Sagara to Talaguppe, a distance of 9·43 miles, has since been undertaken and the line is expected to be opened for traffic by the end of October 1940. This brings the world-famous Jog Falls within a distance of 10 miles from the Railway terminus.

Organisation of the Department.—The General Manager is the Head of the Railway Administration and is assisted by a Personal Assistant in Office. There are six Departments in the Railway, each under a separate head, *viz.*, Engineering, Traffic, Motive Power (Loco), Stores, Medical and Audit. All the departments are under the direct control of the General Manager, except Audit, which is under the Administrative control of the Comptroller. The Auditor has three functions, *viz.*, (1) Independent Auditor, (2) Chief Accounts Officer and (3) Financial Adviser to the Administration. For purposes of working,

MILEAGE AND COST

			Miles	Capital cost Rs. in lakhs.
1. Lines worked by the Madras and Southern Mahratta Railway Company—				
Kolar Gold Fields Railway (Broad Gauge) ..			9·88	12·38
2. Lines worked by the State—				
Metre Gauge (3′–3⅜″)				
Bangalore-Harihar	..	.. 210·49		
Yesvantpur-Hindupur	..	.. 51·19		
Bangalore-Mysore	..	.. 86·01		
Mysore-Chamarajanagar	..	.. 38·09		
Mysore-Arsikere ..	..	.. 102·95		
Birur-Anandapuram	..	.. 73·95		
Anandapuram-Sagara	..	.. 16·33		
Chickjajur-Chitaldrug	..	.. 20·90		
			599·91	603·02
Narrow Gauge (2′–6″)				
Bangalore-Bowringpet	..	..	.. 102·20	45·16
Tramways (2′–0″)				
Tarikere-Narasimharajapura		.. 26·60		
Tadasa-Hebbe ..	..	.. 9·60		
			36·20	13·14
			738·31	661·32
GRAND TOTAL ..			748·19	673·70

Note.—The gross earnings of the Railway were Rs. 85 lakhs for 1939–40 and net earnings nearly Rs. 29 lakhs.

the Engineering and Traffic Departments have been divided into two districts, with headquarters at Bangalore and Mysore.

Development since 1926.—Apart from the rapid extension of the Railway lines in the State since 1926, certain steps have been taken to strengthen the relationship between the public and the Railway Administration, the important one being the formation of the Advisory Committee in 1929, consisting of the General Manager as the Chairman, the Traffic Manager, the Presidents of the District Boards, an elected representative of the Chamber of Commerce and a representative of Women's interests, as members. The Committee meets every quarter to consider matters relating to facilities to the travelling public and the development of merchandise traffic.

With the resumption, on 1st January 1938, of the Bangalore-Harihar and Yesvantpur-Hindupur sections worked by the M. &. S.M. Railway, the Mysore State Railway has transformed itself into a Class I Railway. Foreseeing the increased demand for outturn and production in the workshops, the scheme of Expansion of the Workshops was started in 1933–34 at a total estimated cost of Rs. 12 lakhs and was almost completed by the close of 1938.

With a view to popularising the use of the Railway by the public, the rates and fares were reduced greatly from 1st July 1937 on the original lines, and from 1st January 1938 on the resumed lines. Intermediate halts have been provided on most of the sections of the Railway, where Shuttle trains stop for the convenience of the villages nearby. The increased popularity of Railway travel is shown by the fact that a greater number of trains has had to be introduced to meet the traffic requirements.

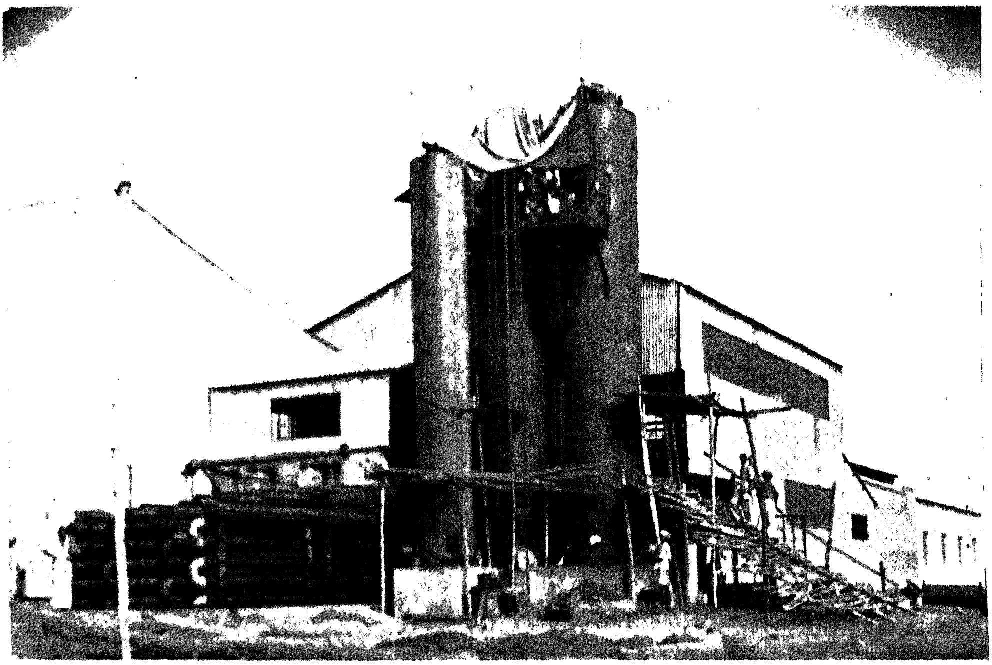
The Railway has also maintained since 1st January 1936, an auxiliary service of road buses plying between Shimoga and Sagara under monopoly obtained for the service. Arrangements have also been made to run additional buses from Sagara right up to the Travellers' Bungalow at Jog Falls during the season from November to May.

Among the many facilities provided for the travelling public may be mentioned the larger waiting accommodation at stations, electrification of stations where power is available, construction of suitable Retiring Rooms at important stations for use by passengers at reasonable charges, and improvements to station buildings and yards at important places.

Realising the importance of a through and direct connection between Bombay and Colombo, the Government of India have recently agreed, at the instance of the Government of Mysore, to the undertaking of a traffic survey by the South Indian Railway. One of the Traffic Officers of the Mysore State Railway will be associated with the Survey. The line when constructed, will establish direct Metre Gauge connection between the southernmost point in India and Poona and Manmad in the north.

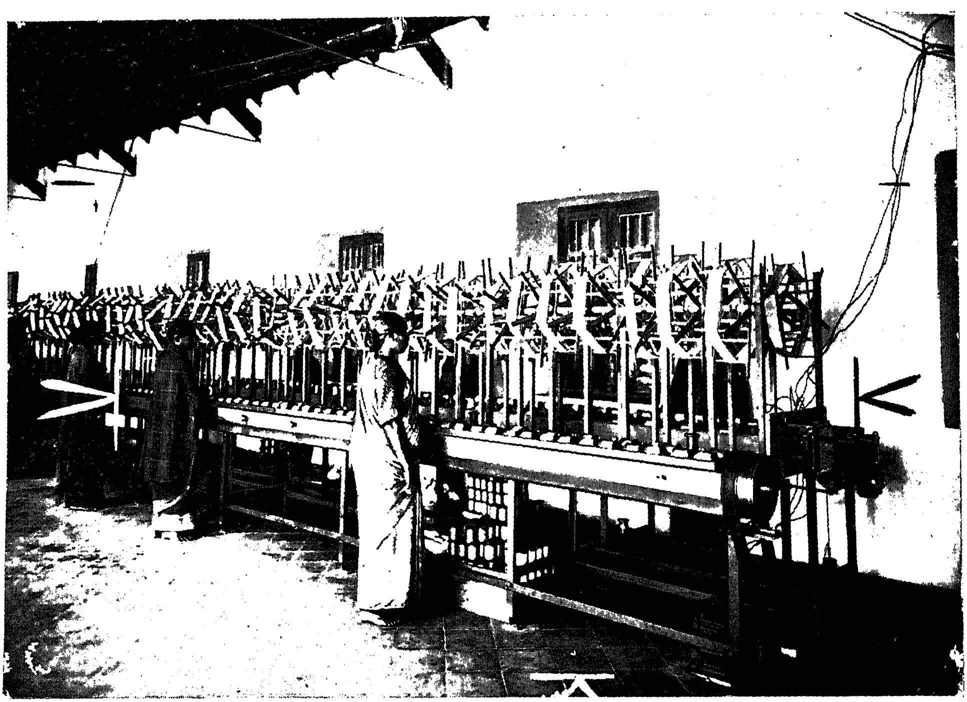
Y. K. RAMACHANDRA RAU.

PAPER MILLS (A SECTION), BHADRAVATI



MYSORE CHEMICALS AND FERTILIZERS, BELAGOLA

SANDAL OIL FACTORY, MYSORE



TRADE AND COMMERCE IN MYSORE

IT is a matter for genuine pleasure and justifiable pride to review the steady and rapid growth of Trade and Commerce in Mysore during the last twenty-five years. With an area of 29,000 square miles and centrally situated in the south of the Indian Continent, Mysore is a fairly large Province, endowed with all the choicest gifts which Nature can bestow, rich in mineral wealth and natural resources and capable of being developed into an agricultural and industrial State, which could compare very favourably with any advanced country in the East or in the West.

The people of the State were extremely fortunate in having had as their Ruler our late lamented Sovereign, His Highness Sri Krishnarajendra Wadiyar Bahadur of revered memory, whose irreparable loss last month is being mourned by all his devoted subjects. With the vision and foresight of a great Nation-builder, His late Highness laid the foundations of a well-planned policy and programme for the development of the economic potentialities of the State which has received universal encomiums. His Excellency Lord Linlithgow, the Viceroy of India, paid this glowing tribute during the State Banquet at Mysore in January of last year:

> "When we leave Mysore, we shall take away with us a picture of a city of great natural beauty embellished by Your Highness' care and an admirably governed State, the great natural resources of which have been developed by Your Highness' devoted labours of over forty years for the prosperity and happiness of your people."

The characteristic features of our trade in the important commodities can be analysed as follows. Amongst articles of food, Ragi, the staple crop, has an acreage of 22 lakhs out of the total cultivated area of 63 lakhs. All this is consumed locally. We imported pulses and grams worth Rs. 57 lakhs in 1920, which fell to Rs. 25 lakhs in 1936. In the case of Rice, there are 7 lakhs of acres under the crop, and the imports declined from Rs. 73 lakhs in 1920 to Rs. 60 lakhs in 1936. Though the imports of rice show a fall, in spite of the increase in population, there is still a great scope for increasing the yield by improved seeds and extension of cultivation under canals and tanks. The import of fresh fruits and vegetables was Rs. 16 lakhs in 1936 and the exports Rs. 32 lakhs. The State has a good export market in copra and cocoanuts, which has increased from Rs. 34 lakhs in 1915 to Rs. 48 lakhs in 1936. The export trade in Coffee, with an area of a little over 1 lakh acres, has been depending mostly on the vagaries of the international market. It went up to as high as Rs. 26 lakhs in 1923 and as low as Rs. 6½ lakhs in 1935, with an annual average of Rs. 12 lakhs.

The growth of the Sugar Industry in the State is very remarkable and significant. In 1931 with practically no export, we imported Rs. 21 lakhs of refined sugar, whereas in 1938 with a small import of Rs. 3 lakhs we exported sugar worth Rs. 57 lakhs, after meeting all the local requirements. Besides, we also exported Rs. 6 lakhs of jaggery. This has increased the area under sugarcane from 30 to 50 thousand acres, most of which is in the Irwin Canal area, where the Government Sugar Factory is situated. In the case of edible oils and oil seeds, in which we had a very small import, amounting to Rs. 27 lakhs in 1936, the exports of these were Rs. 65 lakhs in the same period. During the period from 1915 to 1936, the export of manufactured Tobacco has increased from Rs. 35 to Rs. 64 lakhs, and that of raw tobacco from Rs. 4 to Rs. 18 lakhs, while there is an appreciable decrease of imported tobacco, from Rs. 52 lakhs in 1931 to Rs. 28 lakhs in 1936, and from these figures it can easily be imagined to what extent the growth of tobacco—the improved varieties in particular—is being encouraged and what added prosperity it has brought to cultivators and manufacturers.

The trade in Cotton Yarn and Piecegoods has shown a remarkable increase during the last two decades. The imports of yarn and piecegoods have fallen from Rs. 319 lakhs in 1918 to Rs. 177 lakhs in 1936, while in the same period the exports have risen from Rs. 119 lakhs to Rs. 129 lakhs, beginning with Rs. 17 lakhs in 1915, thus indicating the great development and further scope for the textile industry in the State. From the figures for Raw Cotton, it is seen that the acreage has gone down from 155 thousand in 1917 to 85 thousand in 1937, and, with the increasing demand, the imports of raw cotton

have risen during the same period from Rs. 20 to Rs. 43 lakhs. It is high time that measures are devised for increasing the acreage with improved varieties, preferably in the vicinity of mills, as freight is a very important factor to be reckoned with, in the Textile Industry. It is gratifying to note that this question is engaging the serious attention of Government. The export of raw and waste silk has declined from Rs. 80 lakhs in 1925 to Rs. 22 lakhs in 1936, with the result that the ryot had to cut down the acreage under mulberry from the peak figure of 45 thousand acres to a bare 6 thousand in 1937. The starting of the Mysore Filature and the Spun Silk Factory has given some impetus to this dying industry, but no effort on our part, however great, will enable it to revive fully, unless there is an immediate and thorough review of the Tariff on imported silk, which is a matter for the serious consideration of the Government of India. Our exports of Woollen Druggets and Carpets and of Woollen Piecegoods, have increased from Rs. 11 lakhs in 1915 to Rs. 70 lakhs in 1936, showing thereby the vast possibilities in woollen manufactures.

In the case of Soap, while the imports have risen from Rs. 1 lakh to Rs. 14 lakhs, the exports have also risen from a bare Rs. 1,258 to Rs. 10 lakhs between 1915 and 1936.

The import of Chemicals, Explosives, Drugs and Dye-stuffs has been varying between Rs. 70 and Rs. 90 lakhs between 1931 and 1936, while the export has been Rs. 24 lakhs in 1936, thus providing increasing scope for our chemical industries. In the case of Iron and Steel, the import has been fluctuating between Rs. 32 to Rs. 79 lakhs from 1920 to 1936, while the exports have risen from Rs. 4 lakhs to Rs. 79 lakhs during the same period, with greater increases in recent months since the outbreak of the War. We have imported between 1915 and 1936 Machinery (excluding Railway Plant and Rolling Stock) valued at Rs. 978 lakhs which is an index of the growing industrial expansion in the State. In Gold Mining our annual exports have varied between Rs. 2½ to 4 crores. Summing up these figures, we find that in 1915 the grand total of the Rail-borne Import and Export trade in the State was Rs. 16 crores and 50 lakhs, which has risen to Rs. 24 crores and 62 lakhs in 1936, proving beyond doubt the increasing prosperity of the State in all directions. Figures up to 1936 have been taken, as these were the latest available. But, as a result of the industrial drive in the State in recent years and the fillip given by the present War, in which the potentialities of Mysore are being fully and advantageously utilised, we have made, and are making, still greater strides.

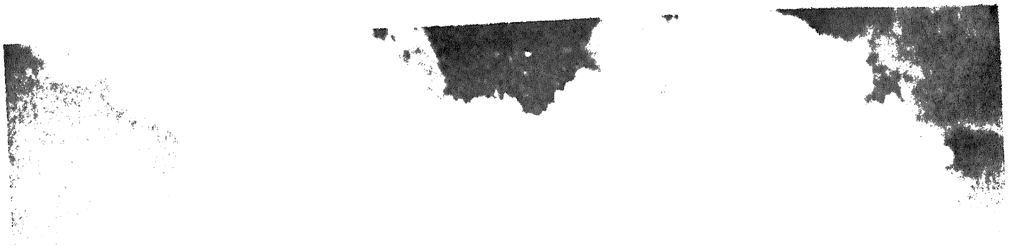
The progress we have achieved is in no small measure due to the fundamental policy animating the Government of His Highness the Maharaja to utilise to the fullest possible extent all the available natural resources for the development of the agricultural, industrial and mineral wealth of the State with its immediate effect in the raising of the standard of living of the people and increasing their prosperity. The production of electrical energy in an ever-increasing measure, its easy availability in all parts of the State at cheap rates, the improvement of communications both by rail and road, and the extension of the Telephone system, have greatly facilitated the growth of industries and commerce. Added to these, the Government's policy of investing its increasing revenues in irrigational, hydro-electric and industrial schemes, as well as in other nation-building projects, like Public Health, Education, Town-planning, and Water-supply, has created a "virtuous" circle of increasing investment, resulting in increasing production, trade and prosperity. The cities of Bangalore and Mysore with their vast industrial and business centres and public institutions, and the trunk road connecting them passing through growing towns and prosperous villages, provide an unique combination of rural and urban prosperity an indication of the agricultural, commercial and industrial activities of the State and are living monuments of the great work of our late Sovereign and his trusted Dewan, Sir Mirza Ismail.

The Mysore Chamber of Commerce, started in 1916, has rendered yeoman service to the commercial community of Mysore. The Bank of Mysore, started with Government patronage, has given the lead for the sound financing of industries and commerce, and its work in the last quarter of a century has been remarkable. The proximity of the Indian Institute of Science has in many ways helped in carrying out chemical and industrial research. Government have also provided ample opportunities for the close association of officials and non-officials to plan out and participate in all these developments,

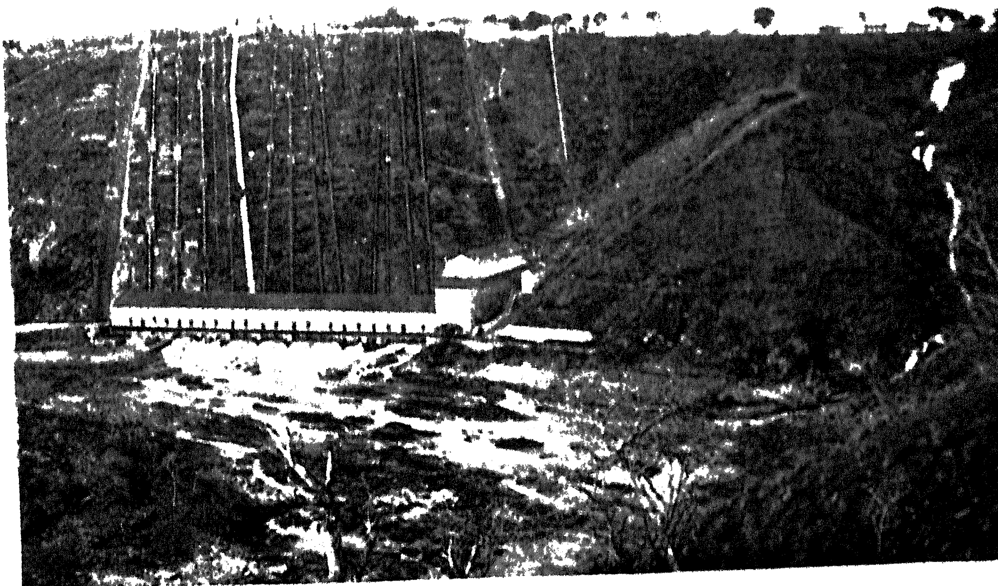
We, in Mysore, owe a deep debt of gratitude to the great administrators, Sir K. Seshadri Iyer, Sir M. Visvesvaraya and Sir Mirza Ismail, who have contributed very largely to the remarkable progress achieved so far, with their sole ideal of loyal and devoted service to their Royal Master, the State and its people.

We are fully confident that our Sovereign His Highness Sri Jaya Chamaraja Wadiyar Bahadur, with his liberal education and broad outlook, will keep up the high traditions of Mysore as a 'Model State', fulfilling the noble mission of his illustrious uncle, so inspiringly expressed by him sixteen years ago, "We in Mysore form, as it were, a nation within a nation. While co-operating with both the Indian Government and the rest of the Indian public in measures which lead to the prosperity of the country as a whole, we in our local sphere should promote education and economic growth to the fullest extent permitted by our resources."

DEVARAO SHIVARAM.



FOREST RESEARCH LABORATORY, BANGALORE



HYDRO-ELECTRIC STATION, SIVASAMUDRAM

Current Science, Vol. IX, 1940

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Errata

Vol. 9, *No.* 3, *March* 1940: (1) Editorial Article, p. 106, first quotation: *For* "And Isaac interested" *read* "And Isaac intreated"; *For* "the Lord was interested" *read* "the Lord was intreated". (2) Contribution entitled "Calcium Utilisation from Green Leafy Vegetables", p. 124, second column, first line: *For* "the skim milk" *read* 'its"; (3) Contribution entitled, "Kostanecki Acylation of Orcacetophenone", p. 118, lines 13 and 14: *For* "Orcacetophenone and its monomethyl ether on benzoylation gave", *read* "Orcacetophenone on benzoylation gave"; (4) Contribution entitled, "Asynapsis in Chilli (*Capsicum annuum*, L.)", p. 126, para 1, first line: *For* "meotic" *read* "meiotic"; Fifth line: *For* "such as" *read* "in". Para 2, line 9: *For* "(Fig. 1)" *read* "(Fig. 2)"; line 11: *For* "(Fig. 2)" *read* "(Fig. 1)". P. 127: It must be noted th Figs. 6, 7 and 8 are reduced to 4/5 and Fig. 9 ½ the original; P. 128: at the bottom of the no *for* "Imperial Agriculture Research" *read* "Imperial Agricultural Research".

Vol. 9, *No.* 9, *September* 1940: Supplemen Article entitled, "His Highness Maharaja S Jaya Chamaraja Wadiyar Bahadur," p. i column 2, third line, *for* "reigns" *read* "reins"

Vol. 9, *No.* 10, *October* 1940: Review artic entitled, "Excavations at Harappa", para 5, lir 6, *for* "Mr. Vats" *read* "Mr. Mohammad Sar Ullah".

Vol. 9, *No.* 11, *November* 1940: Review artic entitled, "Science in War", *for* "Price 6*sh.*" *rec* "Price 6*d.*".

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